LOCKSMITHING

JOSEPH E. RATHJEN

From Apprentice to Master

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From Apprentice to Master

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Joseph E. Rathjen

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To my children, Joseph, Nicole, and Brittany.
May you one day realize that education, hard work, and
persistence always ensure a successful future.

Love,
Daddy

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Foreword

Education is the key to success. How many times have we heard that phrase? How often have we heeded it?

The stark reality is that those of us who take the time to educate ourselves and our customers are more likely to feast on steak than hamburger. As a locksmith, you know how rapidly the security industry is changing. You are on the front lines; retreat is not an option.

So what can you do to ensure your place in the market? Stay current and keep in touch. When you realize that almost 25 percent of your time on the job is spent educating your customers, it is essential that you keep current. Recommending start-up jobs or upgrades dictates that you represent yourself as a security professional who is able to see the entire security picture. If that means broadening your skills beyond cutting keys and opening locked vehicles, then you need to be prepared and educated.

The locksmith enjoys a unique position in the security industry. No matter how sophisticated the technology becomes, the lock and key remain the primary line of defense for residential or light commercial structures. After most residential or commercial break-ins, only the police reach the scene before the locksmith.

In this instance, the locksmith becomes the focus of preventive security. A locksmith who approaches his or her vocation as a "security professional" capable of consultation, recommendation, system installation, and service has many options.

The educated locksmith interested in expanding his or her business to ancillary areas has a foot in the door at the time of crisis. The ability to service your client as a technician skilled in mechanical locking devices and other forms of physical security is to your benefit. It also benefits your client who has put their trust in you.

The scope of the locksmith profession is defined by the people who practice its art. Aiming high and preparing yourself to enter the marketplace as a security professional will substantially enhance both your monetary and intrinsic rewards.

The initial investment in the profession is limited only by your goals. Whether you are learning your craft at a locksmith school or correspondence course, or continuing your education at comprehensive seminars like Ledgerworld, the commitment to sharpen your skills is an enlightened investment.

After almost a decade of work in the physical security field, one fact has never ceased to amaze me: the vigor with which most locksmiths approach their profession and their incredible thirst for knowledge.

Expanding one's horizons usually means expanding the bookshelf as well. In that regard, I have never met a locksmith who doesn't appreciate an informative resource book.

This is such a book. Although the author describes some of the business and technical aspects of the profession, this book is more than a primer for the entry-level locksmith. (It is a superb beginners book, too!)

Part one of the book is an excellent resource for continuing education outlets and publications, new tools in the marketplace, sources for code books and product catalogs, ways to specialize your skill, certifications, general laws and regulations, and business help. Part two details the latest techniques and technology.

The days when the locksmith belonged to the realm of the tinkerer are gone forever. This is a vibrant and exciting profession that stands to grow along with today's technological explosion. Yet like any business endeavor, it is what you make of it. There will always be a place for those content to handle the basics of key cutting and car openings. The opportunity to expand into electronic access control, basic CCTV, and intrusion detection is also waiting for the progressive security professional.

The future is limited only by your knowledge and initiative.

Steve Lasky
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Introduction

Starting a new career can be accompanied by doubts, frustrations, and bewilderment. If you are not fortunate enough to have an experienced professional or friend by your side who can give you expert guidance and advice, then getting a new career move off to a fresh running start or expanding an existing one can be quite difficult.

With this thought in mind, I have written **Locksmithing: From Apprentice to Master** for the purpose of helping individuals interested in starting a locksmithing career and supplying them with a competent, modern, and realistic understanding of what the locksmithing profession is all about. To reach that end, this book talks about how to obtain the proper education, choose the proper tools, find employment, and start and run your own small locksmith business.

During the past few decades, the locksmithing profession has grown by incredible leaps and bounds. Technological advancements within the security industry have enabled the professional locksmith to become more than just a mechanical lock installer and a cutter of keys. Traditional locksmithing is now intertwined with high-end security product design and services, such as electronic access control, burglar alarms, sophisticated time-lock technology, and high-tech safety and computerized anti-theft devices for automobiles. This new measure of professional versatility has opened up many avenues to the professional locksmith and made the profession attractive and lucrative.

Almost anyone can become a locksmith: men, women, working adults, students just out of high school or college, retirees, or those searching for a new career or a quick way to supplement their present income. Unlike many other professions, locksmithing enables you to learn in the privacy of your own home through correspondence courses, and then become quickly and actively involved for a small, initial investment. You can even pick your own work hours. This book offers comprehensive, updated information about locksmithing that you will find nowhere else.

The information is presented in two parts. Part one tells you how to obtain the proper education. There is more than one educational option available to individuals who want to learn all there is to know about locksmithing. The alternatives include schools, correspondence courses, trade publications, apprenticeship programs, seminars, and professional locksmith associations. A complete listing of all these organizations and how to approach and utilize them is included.

Chapter 3 discusses the tools you will need and how to find them. The locksmithing profession demands a large inventory of specialty tools and equipment. This chapter will help you determine a workable minimum investment in tools you will need to launch your new career.

Finding employment in a new profession can also be exceedingly frustrating. Fortunately, this book includes information on how to find a locksmithing job. Chapter 4 is devoted to this important subject.

Many locksmiths specialize in one area of the profession, such as servicing automobile locks, safes, safety-deposit box locks, or master keying. Their reasons for doing so are not only personal, but are based on sound business strategy. Once word gets out that you can provide a particular service quicker and better than anyone else, your list of clientele will grow rapidly. In chapter 5 I examine each of the specialized areas of locksmithing, and provide information on how to select one, the necessary tools and how much they cost, and almost everything else you need to know.

Chapters 6, 7, and 8 talk about locksmithing law, furthering your career goals, and how to start and run your own, small locksmith business.

Part two focuses on basic and advanced locksmithing techniques. You will learn about the different types of locks and their designs and functions. Then you will learn how to pin locks, rekey lock cylinders, originate keys, and master key a small group of pin-tumbler locks. You will also learn about interchangeable cores, high-security locks and keys, and the most modern microprocessed alarm systems. Learning this information through professional courses of study might cost you hundreds or even thousands of dollars, much more than the cost of this book.

Although part two does not represent a complete, basic locksmith course, most of the information included in it will allow you to immediately begin supplying basic locksmith services to friends, family, and, once you are equipped, to the general public.

This book does not promote professional locksmithing, nor is it a guide for the do-it-yourselfer. It is a serious book that will give you priceless information with which to launch a serious career.

Good Luck!

Part one

Building the foundation for a prosperous locksmith career

1

Locksmithing today

The business of locksmithing, as well as that of security in general, has grown by leaps and bounds in the past few decades. This is due to the public's outcry, as well as private industry's desire for more sophisticated and effective security measures. Long gone are the days when having one simple lock on a house or store door (or even a car door) constituted a substantial measure of protection. As the skills and activities of amateur and master criminals grow, so must the effectiveness of the security products that stand in their way. Fortunately, for the public and the locksmith, this demand has created a whole new arena of specialized products and services, for which only today's modern locksmith is properly educated and prepared to install, service, and supply.

For example, the addition of high-tech, automotive antitheft ignition systems like General Motor's VATS and Supplemental Inflatable Restraint systems (airbags) have enabled locksmiths to corner the most lucrative part of the automotive lock-repair market. Due to the sophisticated training and tools needed to perform ignition lockout services and repairs on these types of cars, locksmiths are receiving a much higher fee than they did in the past.

Automotive locks are not the only kinds of locks that have become more sophisticated. With the advent of electronic access control products, locksmiths now integrate traditional mechanical lock services with those of electronic and even computerized products. Microprocessed keypad, datachip, and card-access activated lock systems are growing in popularity and demand, and creating additional opportunities for trained locksmiths.

Other products like burglar alarm systems, home automation systems, and surveillance cameras are now more technologically advanced, smaller, and at the same time easier to install. This allows professional locksmiths to work in a technically varied field of operations, and at the same time to offer superior protection services to the public in general. This in turn creates employment opportunities and higher wages for more advanced skills.

WHAT LOCKSMITHS DO

Locksmiths, fundamentally, supply mechanical, electronic, or computerized security. Leonard Singer, founder of *The Locksmith Ledger International* magazine, the largest publication of its kind, wrote the following definition of a locksmith:

> They are craftsmen because of their technical skills. They are professional because they adhere to a strict code of service ethics and public responsibility; and some are even called scientists because they deal with the laws of physics as applied to the actions of locking devices.

It is ironic that, even back then, Singer understood that being a locksmith was not only a technical achievement, but also one of the most honorable and trustworthy professions in the world. He also foresaw that the profession of locksmithing would be around forever, and that it would most likely always survive, no matter how technologically advanced its industry became.

If you look up the definition of a locksmith in a dictionary, you will probably read something like:

> lock.smith (-smith')n. a person whose work is making or repairing locks and making keys.(1)

That dictionary definition is quite narrow. For a more definitive version, take into mind *Subchapter 15*, of the **City of New York's Administrative Code** concerning locksmiths and keymakers (as of 1/93): S 20-298. Definitions. Whenever used in this subchapter, the following terms shall mean:

> Locksmith. A person dealing in the mechanical actions, and the correct operations of all locks, key or keyless, or similar devices, and whose trade or occupation is duplicating keys, repairing, servicing, installing, inspecting, opening and closing such locks by mechanical means, other than with the regular key made for the purpose, without altering, marring or destroying the original condition or effectiveness of such locks or similar devices in any shape or manner, or a maker or manufacturer of locks, pressure keys, skeleton keys, pass keys, jigs, or any other mechanical device to aid a locksmith in the plying of his or her trade.

Not only is New York City's definition of a locksmith much clearer, it states that to be a locksmith, one must have a professional understanding of and the skills necessary to work with locks and similar security devices.

Let's look at the industry's definition of a locksmith. In the March 1992 issue of *The Locksmith Ledger Magazine*, the publisher/editor wrote:

> A locksmith is an individual who has the ability to key a lock, install a lock, repair a lock, and bypass/neutralize a lock.

All these definitions, however, do not come close to describing the complete business of locksmithing. The rest of this chapter will outline exactly what locksmiths do, how much money they can make, and what many locksmiths hope to achieve from their profession. Locksmiths reap not only monetary gain, but also personal gratification from supplying security, a crucial public service.

Nothing is more satisfying than knowing your skills and actions, and the skills and actions of professionals like you, have prevented burglars, thieves, murderers, and rapists from intruding in the private lives of your clients. The profession of locksmithing is the oldest and most reliable means of protecting one's self, family, and property, and it looks like it will be around for a long time to come.

To give you a better understanding of what locksmiths do, I have supplied you with a detailed list of the services typically performed by a locksmith today.

- installs locks
- originates keys
- picks locks
- installs safes
- repairs safes
- repairs locks
- rekeys locks

- duplicates keys
- master keys locks
- opens locked automobiles
- opens locked safes
- changes safe lock combinations
- installs and repairs automobile alarms
- installs and repairs burglar alarms
- installs electronic access control devices
- installs auxiliary door hardware
- installs intercom systems
- installs CCTV surveillance equipment
- performs 24-hour emergency services
- assists law enforcement officials
- designs, sells, and installs complete security systems
- installs security and storm doors
- installs window gates
- installs home automation products

As you can see from the list, locksmiths do quite a bit more than just tinker with locks. In fact, locksmiths perform more mechanical and electronic security work than most individual security professionals in other lines of work.

The locksmith industry is growing both technologically and professionally at a rapid rate. It is also the only security industry with a major, national following that is driven by private, independent organizations that offer educational opportunities for both apprentices and professionals.

HOW MUCH LOCKSMITHS EARN

Although regional variances and individual business requirements play a róle in determining actual dollar earnings, industry surveys show that the typical locksmith can make a respectable living. Table 1-1 shows the results of a recent survey of prices for each of the basic services performed by locksmiths around the country. Prices for each service are listed separately, along with the price increase and/or decrease from the previous year's survey. You will notice that at the top of the table are the service call and hourly rate averages. To better understand what fee a locksmith might earn for a particular call, like a lockout, add the average price to the service call fee.

WHO HIRES LOCKSMITHS?

Here is a list of a few of the businesses and private consumers who call locksmiths on a daily basis:

- motorists
- private homeowners
- building management companies
- apartment complexes
- realty companies
- automotive shops
- automotive dealers
- automobile manufacturers
- small and large business owners
- insurance companies
- police departments
- city administrations
- public and private schools
- hardware stores
- airports
- marshals
- landlords

Table 1-1
National survey price list (1993)

Service	Average price	Annual rise
Shop work		
Service call (min.)	$27.00	–.06
Hourly rate	$32.88	+.17
Key duplication		
American single cut	$1.32	–.01
American double cut	$1.92	+.04
Foreign single cut	$2.13	–.03
Foreign double cut	$2.60	.00
Flat steel	$2.96	+.05
Flat steel double cut	$3.82	+.09
Tubular key	$4.12	+.23
Bit key	$5.45	+.20
Safe deposit box	$5.08	+.56
High security	$7.29	+.95
Best	$2.93	+.07
Key from broken key (add'l)	$1.89	+.20
Rekey/change combo first key (In shop, add service charge outside)		
Key-in-knob	$8.01	+.02
Rim or mortise cylinder	$7.88	–.01
Pick open cylinders (add'l)	$4.32	+.79
Each add'l key (add'l)	$1.68	+.28
High security (rim/mortise)	$13.31	–.71
Bit keys	$12.38	$.36
Best	$13.72	+.12
Safe deposit box	$16.62	+.56
Locker lock	$11.10	+.36
Tubular	$13.18	–1.14
Automobile locks		
Fit key Ford 10-cut	$39.73	–2.09
Fit key GM-VATS	$101.20	–4.46
Pull GM wheel (in shop)	$29.11	–1.77
Air bag (add'l)	$46.57	+7.81
Telescoping wheel (add'l)	$12.95	+1.31
Obsolete auto lock (min.)	$21.50	–.44
Foreign door & trunk (min.)	$27.49	–.27
Foreign ignition (min.)	$35.18	+.17
Motorcycle	$23.46	–.34
First key by code (automotive)		
American single cut	$7.45	+.21
American double cut	$9.16	+.35

Service	Average price	Annual rise
Foreign single cut	$10.81	+.07
Foreign double cut	$12.10	–.05
Foreign sidewinder	$32.22	–2.33
Flat steel	$10.34	+.93
Flat steel double cut	$12.10	+1.44
Suitcase	$6.08	+.50
Tubular	$12.04	+.08
Safe deposit box	$15.27	+.69
Motorcycle	$11.73	–.04
First key		
By impression (min.)	$12.70	–2.45
By reading	$11.87	–1.13
Padlocks		
Combination by code	$4.35	–.12
First key pin tumbler	$7.84	+.04
First key wafer	$7.13	–.02
Pin tumbler by code	$6.20	+.23
Key stamping per line	$0.48	+.08
Best first key	$14.79	+1.00
High security first key	$17.26	+.49
Door closers		
Repack & refill overhead surface type	$46.72	–.48
Floor checks	$78.70	+3.28

Source: Locksmith Ledger International

LOCKSMITHING AS A FULL- OR PART-TIME CAREER

There are many reasons why more and more men and women are attracted to the profession of locksmithing. One major reason is because of the flexible working hours. Because of the tremendous need for emergency services (24 hours a day) locksmiths are called to service lockouts at all times of the day and evening. Since prices are typically higher for evening work, some locksmiths choose to work only at night and might even specialize in automotive or building lockout work. Working only evenings allows part-time locksmiths to keep their full-time profession.

Educational alternatives

Correspondence courses enable you to learn locksmithing skills in the privacy of your own home. Many of these courses provide materials and tools, which eliminate the need for on-the-job training.

Self-employment

Many people who want to change careers or to work for themselves choose locksmithing. With a small initial investment, many locksmiths can work from their homes or from a mobile shop (van). It is common for one or two locksmiths to go into business together. This is one of the quickest ways to break into the business.

Retirement option

Many men and women love to work with their hands but don't want a physically demanding job after they retire. Locksmithing is an excellent trade for the retiree. It is neither physically strenuous nor financially overwhelming. Anyone, at any age, can become a locksmith.

2

Getting started

Whenever one decides to enter a new profession, the inevitable questions arise of "where and how" to begin. If you're lucky enough to have a close friend or family member who is an employed locksmith, then you'll start your new endeavor a few steps ahead of the game. But not everyone will be that fortunate. How then, can you break into an industry that is often shrouded in secrecy and sometimes still has its best-kept locksmithing secrets guarded by little old men who peer out at you from behind horn-rimmed glasses?

The alternatives are encouraging, and much more accessible than you might first assume. The rest of this chapter will supply you with everything you need to know to learn the craft, which will make it easier for you to decide the most practical and economical way for you to enter this fascinating and lucrative field.

LOCKSMITHING SCHOOLS

Presently, there are only 25 professional locksmith schools in the United States according to directory research information obtained from the industry's major trade publications. A list of these schools is supplied in appendix A. Some of these schools are state-approved courses, which means you can apply for a government (student) loan. Others are privately owned by some of the industry's major manufacturers and supply houses. Most of these schools offer hands-on training classes for in-school students or correspondence courses. Others offer night classes for those who are still working full-time jobs. Course length ranges from six months to two years. After completing these courses, you will be rewarded with either a completion-of-course certificate for a locksmith license or a professional certification and an impressive looking diploma.

Courses

The courses offered by these schools vary. Most of them offer a basic locksmith course and then additional courses that teach the details of each specialized category of locksmithing, such as safe and vault work, automotive lock work, safe deposit box locks, time-lock technology, advanced lock picking, electronic access control, and automotive and burglar alarms.

Tuition

The tuition for these courses varies. Tuition for basic locksmith courses in most of these schools will cost anywhere from $1,500 to $3,000, depending on the skills covered by the course and the amount of included material and tools. Often, tuition can be paid on a monthly basis, in full prior to the start of the course, or the school might provide you with some sort of financing option or might help you obtain a government-secured student loan.

Correspondence courses

Some locksmith schools offer correspondence courses. This is an excellent way to learn at your own pace and in the privacy of your own home. The tuition for these courses, which is usually lower than the fee charged to those who attend classes, includes all the necessary learning materials, such as literature, products, tools, and personal instruction and guidance from industry experts and well-known teachers in the field. You'll be supplied with a reasonable learning schedule, lessons to complete, and an impressive diploma and certification after you complete the course.

One well-known and long-established correspondence school is the Foley Belsaw Institute in Kansas City, MO. Owned by the Foley Belsaw Company, a 50-year-old company that supplies locksmith tools and education around the world, the Institute is known as one of the most reputable and reliable means of correspondence education for locksmiths worldwide. The extras that come with the basic locksmith course are extremely attractive and include a professional micrometer key machine and code cutter. Other course materials are:

- supply catalogs
- high-quality free-key blanks
- business cards
- student technical support

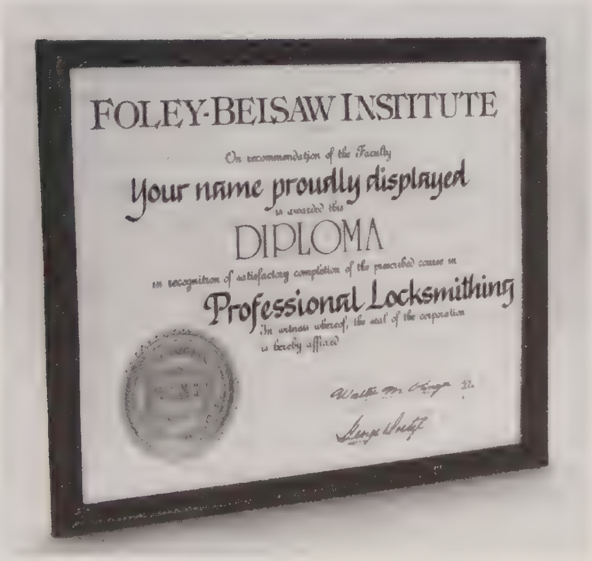
The Foley Belsaw correspondence course allows students two years to complete the full-course, and then gives a free extension period if required. The course is filled with many standard locksmith tools and supplies, which other courses might consider extra (Fig. 2-1). In addition to the basic course, which includes basic locksmithing, high-security, specialty locksmithing, safe and vault servicing and repair, safe deposit lock servicing and repair, and operating a locksmith business, there is also a 24-lesson course in burglar and fire alarm systems, which is included absolutely free. After completing the course, each student receives two impressive looking diplomas (Fig. 2-2).

Another well-known school that specializes in correspondence and resident courses is The Lockmasters Professional School located in central Kentucky. In order to maintain its world-class leadership status, Lockmasters has developed three course curriculums that provide students with some of the most convenient and informative hands-on training available today. Its correspondence course includes comprehensive lessons in the following skills: safe lock servicing, safe deposit lock servicing, and combination lock manipulation. The safe lock servicing course offers more than 23 lessons, the safe deposit lock servicing course 25, and the combination lock course 36 lessons. In addition, each course comes with tools, locks, supportive materials, and a complete course manual in 3-ring, hardcover binders. To ensure continuity between lessons, students are required to submit only one completed lesson per month.

The Lockmasters Professional School was founded in 1955 by three men who have become the most respected experts in the field of physical security: Henry C.

Foley Belsaw

2-1 The Foley Belsaw course. Key machine and tools are included.



FOLEY-BELSAW INSTITUTE

On recommendation of the Faculty

Your name proudly displayed

is awarded this

DIPLOMA

in recognition of satisfactory completion of the prescribed course in

Professional Locksmithing

In witness whereof, the seal of the corporation

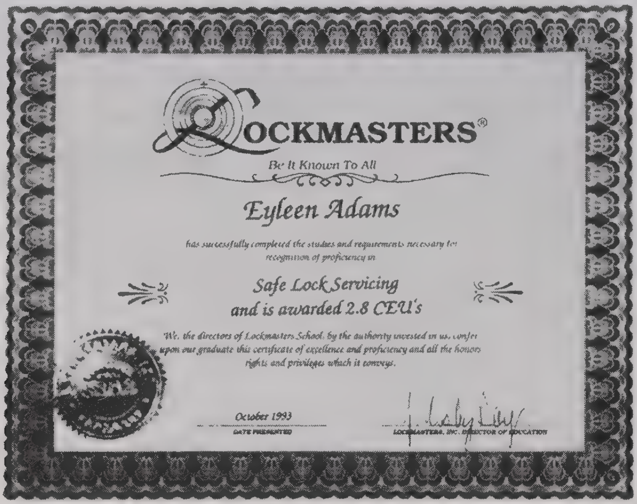
is hereby affixed

Foley Belsaw

2-2
The Foley Belsaw course diploma.

Miller, the pioneer of The Locksmith Ledger and The Locksmith Institute; Leonard Singer; and James Taylor, the founder of the world's largest safe deposit lock manufacturing facility.

After completing each course, students receive an impressive diploma and earn continuing educational units (CEUs) (Fig. 2-3).



LOCKMASTERS®

Be It Known To All

Eyleen Adams

has successfully completed the studies and requirements necessary for recognition of proficiency in

Safe Lock Servicing
and is awarded 2.8 CEU's

We, the directors of Lockmasters School, by the authority invested in us, confer upon our graduate this certificate of excellence and proficiency and all the honors rights and privileges which it conveys.

October 1993
DATE PRESENTED

LOCKMASTERS, INC. DIRECTOR OF EDUCATION

Lockmasters

2-3 The Lockmasters' course diploma.

TRADE PUBLICATIONS AND MANUALS

Industry news and technical information are published routinely in trade publications and manuals.

Magazines

One of the most economical and quickest ways to gain access to an unlimited amount of technical information is to subscribe to one or more of the major locksmith trade publications. These magazines are not available to the public. You usually have to prove some kind of involvement in either an educational or apprenticeship program before you can subscribe. Another way to receive these publications is to have a licensed or certified locksmith sponsor your subscription request. All of these magazines are sent either monthly, bi-monthly, or on a quarterly basis, for no more than the average price of a newsstand magazine.

Each of the trade publications have monthly columns that deal with the technical side of locksmithing and contain priceless information on how to run your own business. They will also keep you up-to-date on the latest trends in security design, security product manufacturers, the legal aspects of locksmithing, the industry's trade show calendar, directory information, and new educational opportunities. They also publish classified ads. If you want to keep abreast of what's going on within the locksmith industry, turn to these publications. A list of these magazines is supplied in appendix E.

Trade manuals

There are literally hundreds of trade manuals available. Most are sold through the industry's major trade publications or distributorships (supply houses). You can find a book on just about any locksmith subject, technical or business, from keys to locks to how to manipulate a safe lock open. Two excellent sources of information on basic locksmithing have been published by TAB Books: *The Complete Book of Locks and Locksmithing*, by Roper/Phillips, and *Professional Locksmithing Techniques*, by Phillips. Both of these books are available in local bookstores or can be ordered directly from TAB Books.

Instructional video tapes

Many of the major manufacturers of locks and auxiliary door hardware are now producing their own video tapes, which show how to install and service their particular products. Available tapes will show you how to open automobiles, change ignition locks, service airbags, install door closers, and perform many other services. These tapes are especially helpful because they let you actually view the work being performed. They are excellent educational tools for groups of locksmiths, schools, and shop employees.

SEMINARS

Many trade publications, distributorships, and manufacturers hold monthly professional training seminars around the country. Most of these seminars are free of charge. You only need to get yourself to one to reap the benefits. Dozens of seminars, conducted by specialists in the field, are at every trade show and locksmith convention. Those that charge a fee usually provide a more in-depth and hands-on course that includes technical literature or tools you can keep. Many of these seminars also send you home with some sort of certification once you complete the class. Seminars provide an excellent opportunity to learn new skills, mingle with other locksmiths, and pick up many of the tips and ideas offered by the instructors and audience members.

APPRENTICESHIP PROGRAMS

Many major trade publications sponsor apprenticeship programs. These programs supply quarterly or monthly publications to individuals just starting out in the business. For a modest fee, you receive a technical newsletter and advice and tips on a wide range of locksmithing subjects. Some of the locksmith schools also secure an internship for you within the industry upon graduation.

EMPLOYER SPONSORSHIPS

One of the most interesting ways to get into the locksmithing industry is to get yourself accepted into an employer-sponsored education program. Many large corporations will pay the tuition costs if you learn locksmithing skills. The reasoning behind these programs is simple. They pay, you learn, and then you work for them using your new skills. These corporations have found that it is financially advantageous for them to train their own employees to perform all the locksmith work in their own buildings. Such a situation could not only help you to move up in a company, but might help you earn more money. If you work for a large corporation, ask if such a program exists. If it doesn't, why not visit your personnel office and make the suggestion?

MANUFACTURERS' CATALOGS

Another useful way to educate yourself about the particulars of any one product is to acquire and read the manufacturer's product catalog. Quite frequently these catalogs include technical brochures that will teach you how to install, troubleshoot, and service their products. They are an excellent source from which to learn the functions of locks, the names of parts, and up-to-date security design concepts. Most manufacturers will send you these catalogs free of charge. You just have to pick up the phone and ask for them.

PROFESSIONAL ASSOCIATIONS

Almost every city and town has a local locksmith association. These associations are member-supported through annually-paid dues. They are an excellent source for education, industry news, legal support, and employment assistance. I strongly recommend that you contact and join your local locksmith association. A complete nationwide listing is included in appendix B.

The locksmith industry has no union. Therefore, most lobbying efforts are performed by manufacturers, trade publications, and professional associations. Only when everyone works together for the benefit of all can an industry survive and protect itself from damaging outside influence or hostile takeover.

DISTRIBUTORSHIPS

Many distributorships are supermarkets that sell education and product display. When you walk into any of the large distributorships, you find an endless display of manufacturers' products. Many distributors also send a free catalog of all the products and educational supplies they stock. Browsing through these catalogs opens up a world of information to you. Every lock manufacturers' products, tools, supplies, and educational manual are within the covers, along with prices and product identification numbers.

Distributors are also very important to your career. When you decide to start your own shop you will go to the distributorship to purchase tools, products, and other materials. A good relationship with a locksmith distributor is important to a prosperous locksmith career. Without them, you simply can't operate.

TINKERING

How does it come apart? How does it go back together? If you're one of those people who would rather pull your washing machine apart bolt by bolt to retrieve a stuck sock in the drain line, then you're probably a tinkerer. You can learn plenty about how locks operate, are put together, installed, and repaired by tinkering with them in your free time. Many locksmiths buy a new product in order to learn how it operates and how to install and service it. Then, when the need arises, they are prepared to service the product. Don't make the mistake of learning products on the job. If you see a lot of one particular lock or product around in your neighborhood, learn about it. A knowledgeable career is comprised of building blocks, one of which is research.

Use caution when you tinker. Before you pull a lock or a lock cylinder out of a door, make sure you have the necessary supplies to repair it. Don't expect a friend or a family member to allow you to pull apart their house locks for the sole purpose of satisfying your technical curiosity. Use common sense and logic when you try to teach yourself basic skills.

After you start your business, your junk bin will become filled with a collection of old locks, parts, and associated locking hardware from your jobs. Use these discarded locks to learn how older locks are disassembled, reassembled, and repaired. They also will help you build an inventory of hard to get parts. Some customers simply refuse to replace that old warded, skeleton-key lock with the glittering glass knob that's been on their bedroom door for the past 50 years. Once they realize you can supply that hard to find spring, your reputation and your customer's respect will grow quickly.

ATTITUDE

Your willingness to learn has a direct effect on how much and how quickly you learn. As a locksmith, you should always keep one important concept in mind: locks secure property, belongings, and the people who own them. Security, no matter its form, is serious business. Therefore, the way you apply yourself to this concept has a lasting effect on your success.

ASK QUESTIONS

When you first enter the locksmithing profession you will have many questions. This is to be expected. But to be a competent professional, you must continue to ask questions throughout your career. Hundreds of different locking products and associated security hardware are available. Even experienced locksmiths are still learning because this fascinating field is advancing technologically at a rapid rate. Even though you will most likely purchase many training manuals or take professional locksmithing courses, there is always more to learn.

The best way to learn is to work at your own pace and to ask questions. Most locksmiths will be more than happy to help you and to answer your technical questions. If you can't find a clear answer to a technical problem in a training manual, write the manufacturer's technical department. Another good way to find hard to get information is to write to one of the industry's trade publications. Their technical columnists will be more than happy to answer your questions.

STICK TO THE BASICS

The desire to get your feet wet fast should not prevent you from developing a good functional background on lock basics. Basic locksmithing principles and techniques are the basis for all security product designs and operations. Only after you have a good understanding of the basics should you attempt to learn about the more specialized locksmithing fields. The following list includes all the current, basic services most locksmiths perform on a daily basis. Learning these basic skills will make it easier for you to secure employment or to get started on your own. Initially, you should:

- understand keys and keyways
- be able to identify key blanks and keyways
- understand standard cylinder construction and operation
- understand basic lock functions
- understand the different lock designs and operations
- be able to install standard lock hardware
- be able to maintain and repair standard locks
- be able to pin and rekey locks
- be able to originate keys
- understand spacings and depths
- be able to cut keys
- be able to cut keys by code
- be able to find key codes
- be able to impression keys
- be able to operate key duplicators and code machines
- understand basic lockpicking
- understand basic lock bypassing procedures
- understand automobile locks
- be able to open locked automobiles

These skills will give you a good foundation from which you can progress to the more specialized areas of locksmithing.

3

The tools of the trade

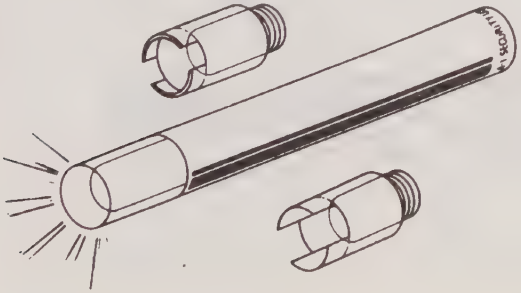
In locksmithing, as in almost every profession, having the proper tools to start and complete a job means the difference between failure and success. There is nothing more frustrating than losing a job, or having to delay its completion, due to a lack of supplies, knowledge, or the proper tools.

Initially, you will be overwhelmed by the number of tools available. Some of these are unquestionably standard locksmith tools. You simply must have them to operate. Others can be purchased as your skills and your technical demands grow.

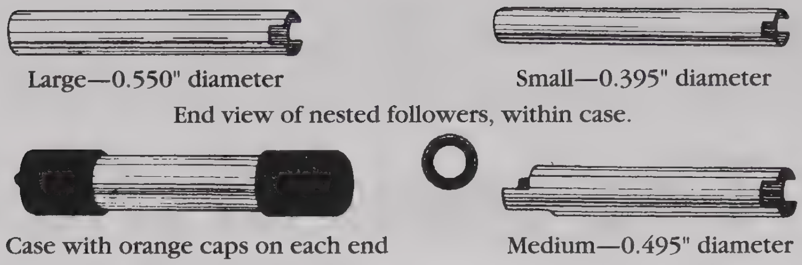
For the purposes of practicality and economic restraints, this chapter will provide you with a listing of all the basic hand, power, and locksmith tools you should have when you first open your business. Also discussed are the other important tools and aids, like codes and trade manuals, that will assist you in your craft. Inevitably, you will need more tools once your skills grow.

STANDARD LOCKSMITH TOOLS

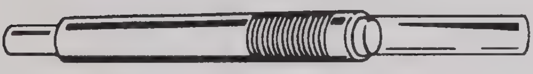
The tools are grouped in three lists: common, everyday tools that you can obtain anywhere, general tools that are unique to the locksmithing craft, and automotive locksmith tools. You might have many of the standard, everyday tools. What you don't have can be bought wherever common tools are sold. The locksmith tools can only be bought at locksmith supply houses. Figures 3-1 through 3-37 illustrate some of the listed tools.



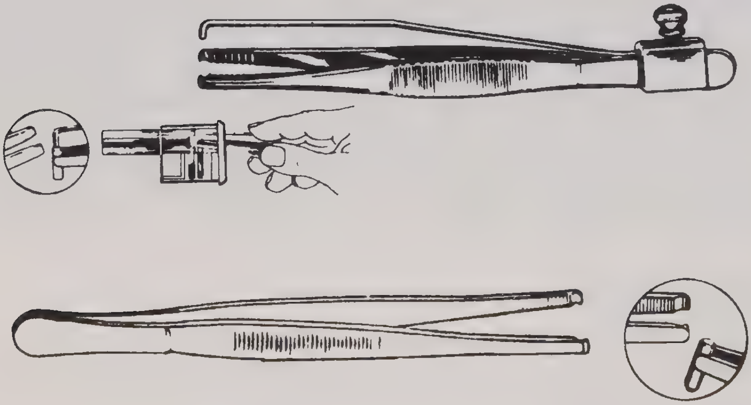
3-1
A lighted plug follower. Accredited Lock Supply Co


Large—0.550" diameter
Small—0.395" diameter
End view of nested followers, within case.
Case with orange caps on each end
Medium—0.495" diameter

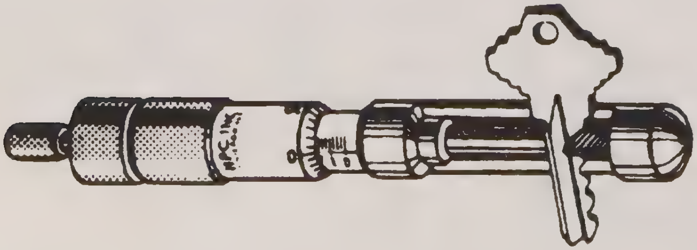
3-2 Plug followers of varying diameters. Accredited Lock Supply Co.



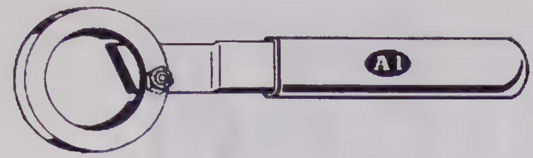
3-3 A shim tool and holder. Accredited Lock Supply Co.



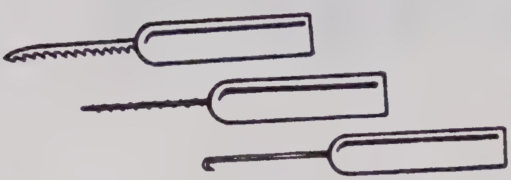
3-4 Pin tumbler tweezers for loading and unloading top and bottom pins. Accredited Lock Supply Co.



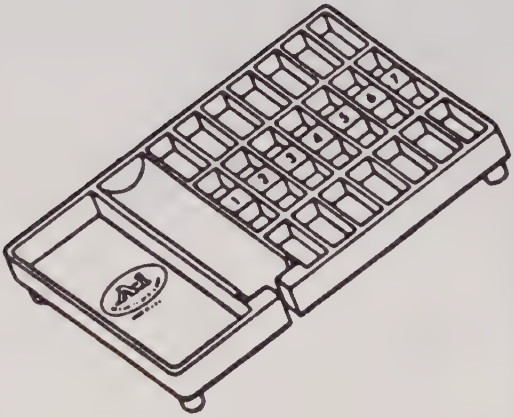
3-5 A key micrometer for measuring depths of cut. Accredited Lock Supply Co.



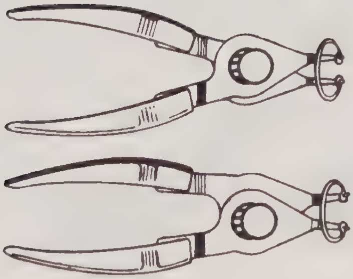
3-6
A cylinder removal tool. Accredited Lock Supply Co.



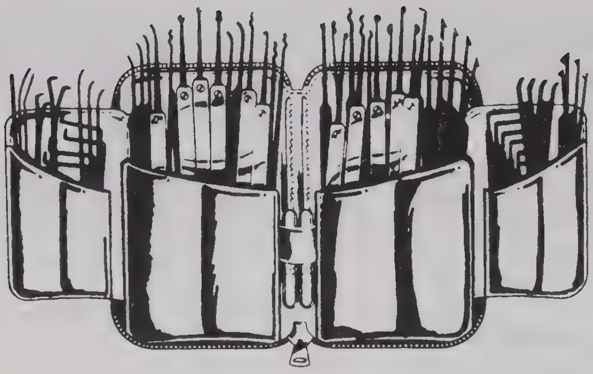
3-7
Broken key extractors. Accredited Lock Supply Co.



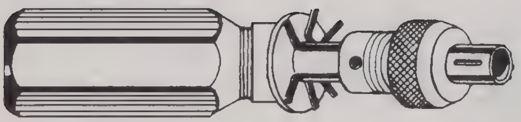
3-8
A pin tray for servicing pin tumbler locks. Accredited Lock Supply Co.



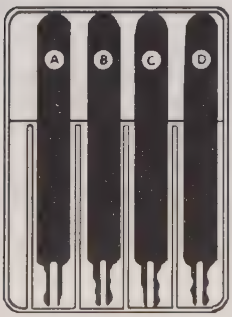
3-9
Truarc Ring pliers for removing cylinder Truarc rings and retainers. Accredited Lock Supply Co.



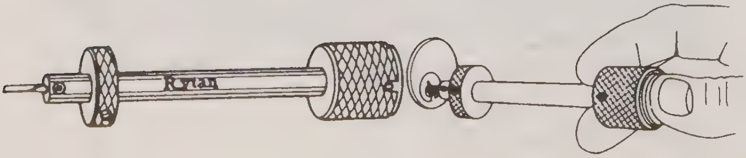
3-10 A professional lock pick set. Accredited Lock Supply Co.



3-11
A tubular lock pick for picking tubular locks. Accredited Lock Supply Co.

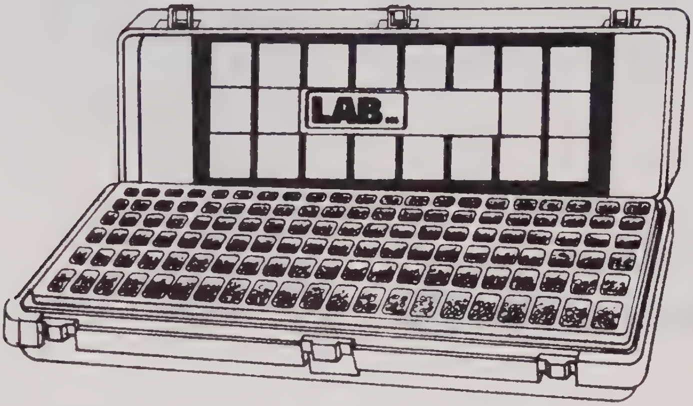


3-12
Wafer lock picks for picking double-sided wafer locks. Accredited Lock Supply Co.

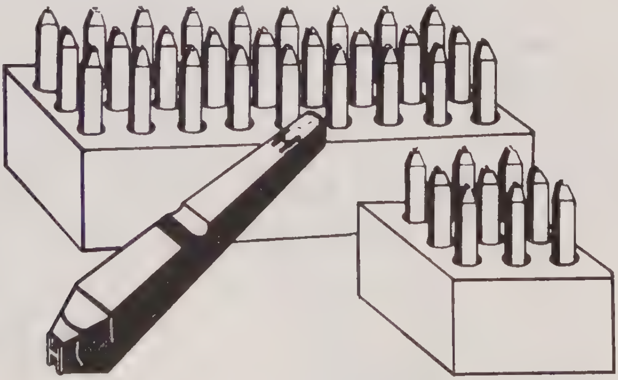


3-13 A plug spinner. Accredited Lock Supply Co

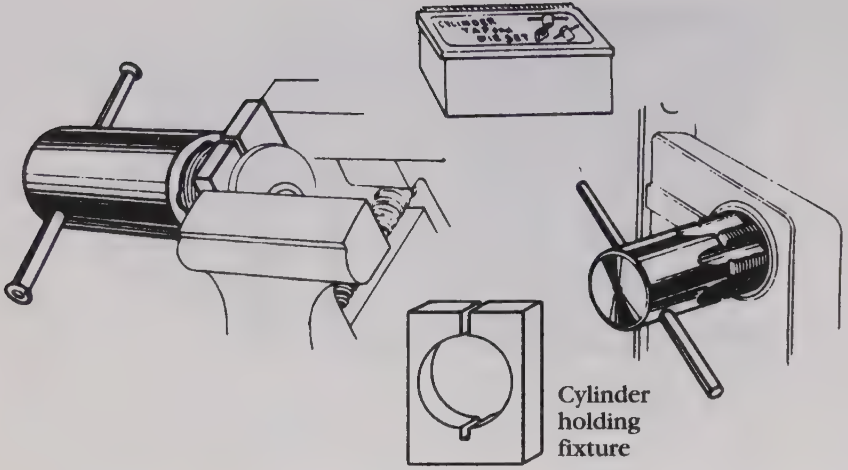
3-14 An interchangeable core pinning kit is needed to service interchangeable cores. Accredited Lock Supply Co.



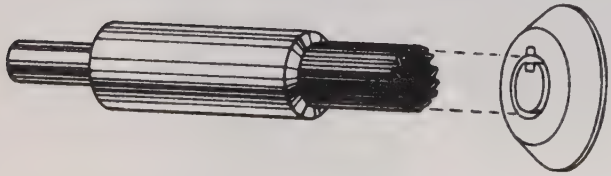
3-15 A pin tumbler pin kit for shop use. Smaller pin kits can be purchased for field work. Accredited Lock Supply Co.



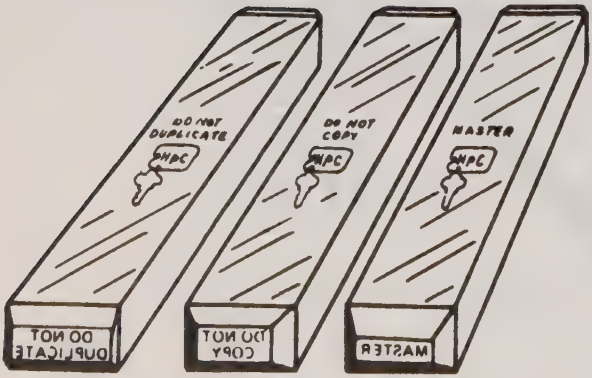
3-16 A die stamp set for marking keys and cylinders. Accredited Lock Supply Co



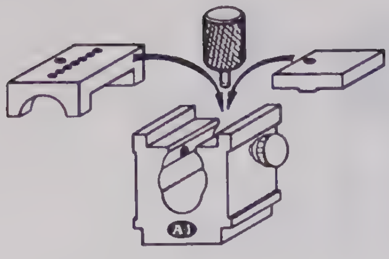
3-17 A mortise cylinder tap and die set is a must for rethreading stripped mortise cylinders and cylinder mounting holes. Accredited Lock Supply Co.



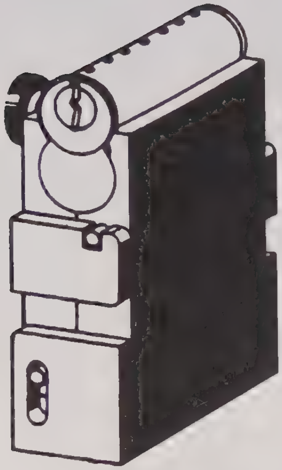
3-18
A tubular lock drill. Accredited Lock Supply Co.



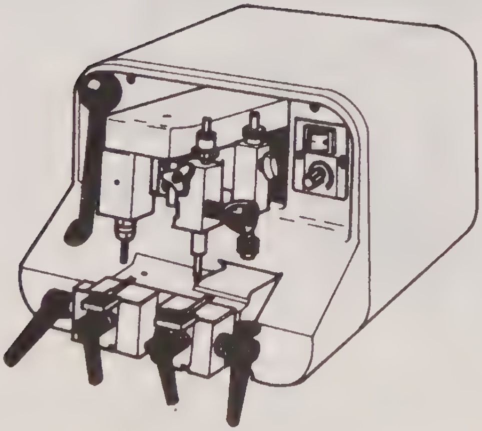
3-19
Locksmith stamps for marking key bows. Accredited Lock Supply Co.



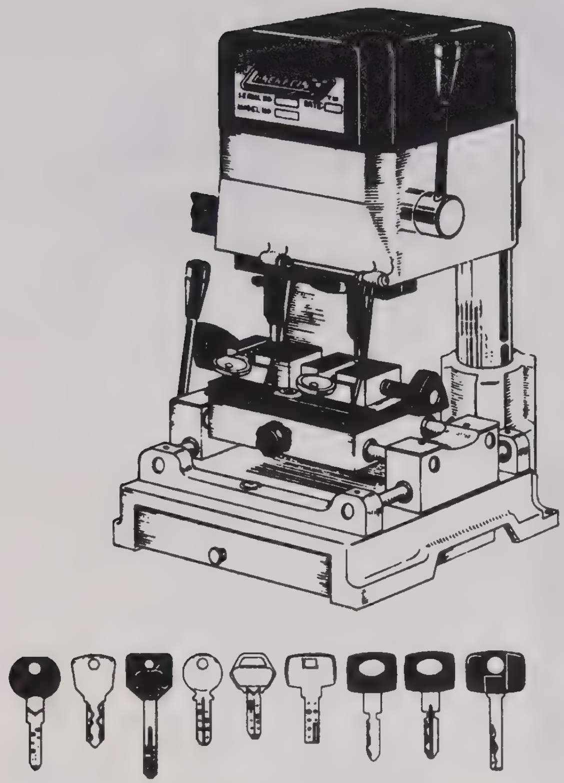
3-20
An interchangeable core capping block. Accredited Lock Supply Co.



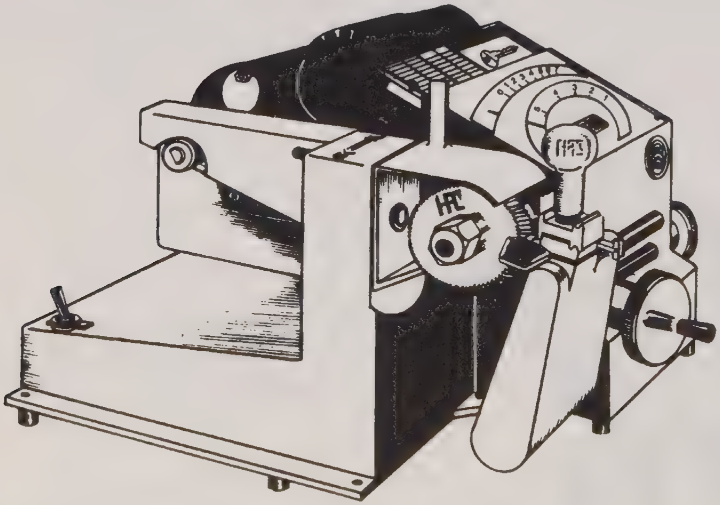
3-21
An interchangeable core servicing tool, also known as the block. Accredited Lock Supply Co.



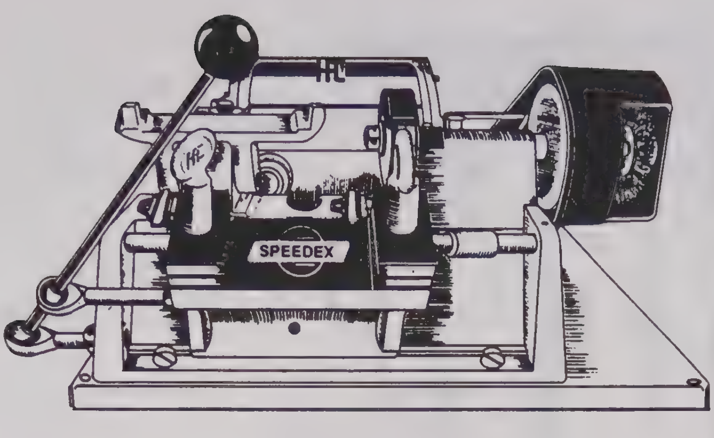
3-22
The Ilco Unican KD55 high-security key machine, for cutting high-security dimple cut keys. Accredited Lock Supply Co.



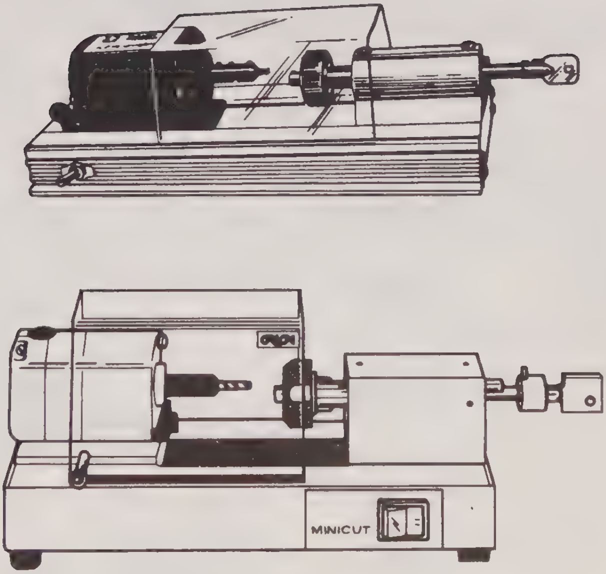
3-23 HPC's laserpoint high-security key duplicator. Duplicates Alfa Romeo, BMW, Lancia, Mercedes Benz, and more. Accredited Lock Supply Co.



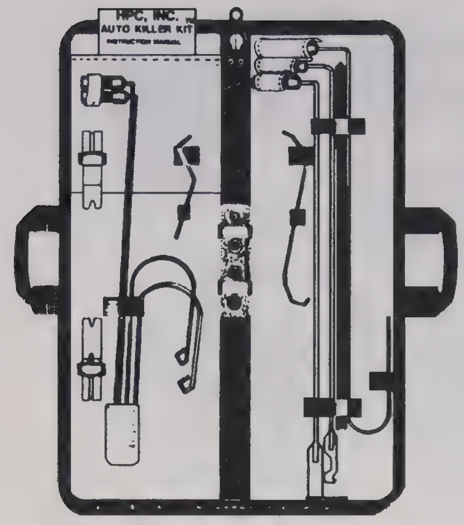
3-24 HPC's 1200 code machine. This machine is one of the fastest for code cutting. It uses plastic micrometer code cards that can be switched in seconds. Accredited Lock Supply Co.



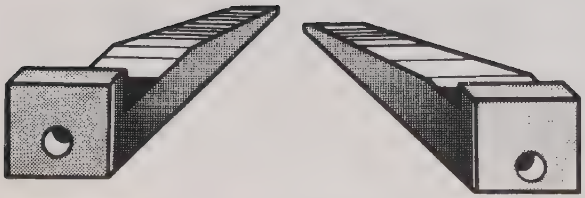
3-25 HPC's 9170MC lever-operated key duplicator. Accredited Lock Supply Co.



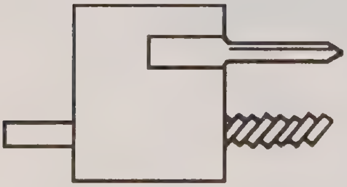
3-26 Two key machines for cutting round tubular keys.
Accredited Lock Supply Co



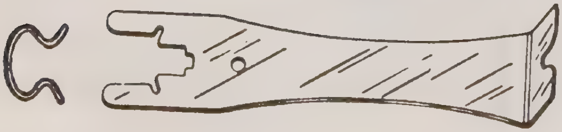
3-27
A car door opening set is a necessity for answering car lockout calls. Accredited Lock Supply Co.



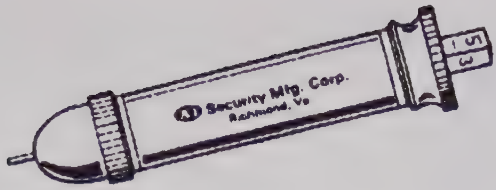
3-28
Auto window wedges for separating the window glass from the door panel. Accredited Lock Supply Co.



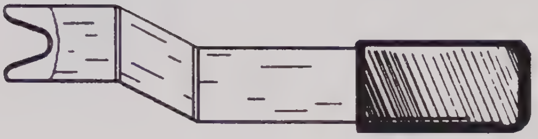
3-29
Ignition drill template for Ford ignitions. Accredited Lock Supply Co.



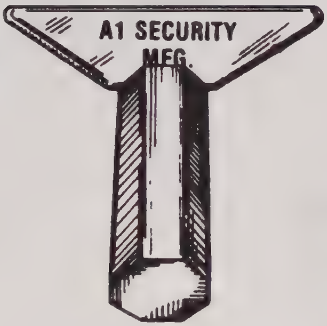
3-30
A clip removal tool for door handles and window cranks. Accredited Lock Supply Co.



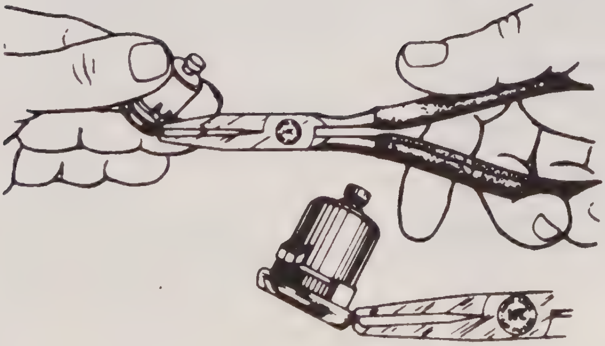
3-31
A GM lock decoder that reads GM tumbler depths. Accredited Lock Supply Co.



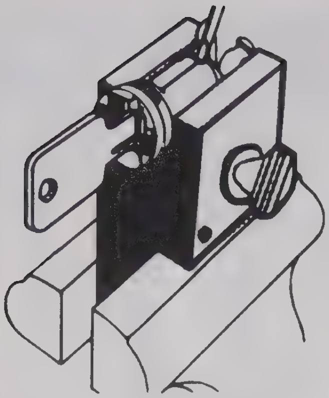
3-32
Automotive door panel clip removal tool. Accredited Lock Supply Co.



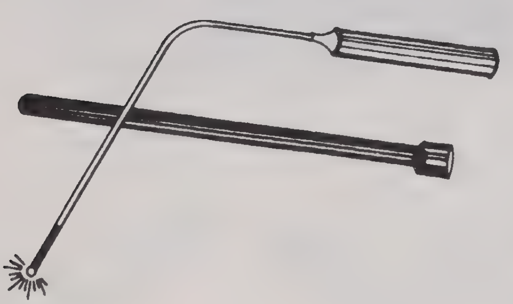
3-33
Bezel nut wrench for servicing GM glove compartment locks. Accredited Lock Supply Co.



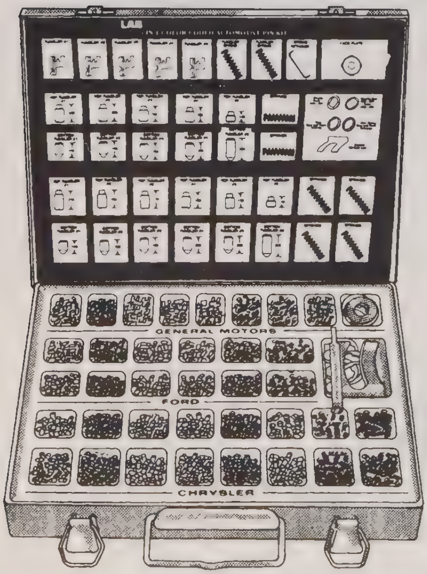
3-34
Auto lock face cap pliers. Accredited Lock Supply Co.



3-35
Retainer staking fixture for GM auto locks. Accredited Lock Supply Co.



3-36
A flexible shaft probe light for illuminating car door lock linkages. Accredited Lock Supply Co.



3-37
Three-in-one auto lock pin kit for Ford, GM, and Chrysler. Accredited Lock Supply Co.

Common Hand, Bench, and Power Tools

- screwdrivers: flat, phillips, assorted sizes, offset
- drivers: hex, torx, pozidriv
- nut drivers: assorted sizes
- vise grips: straight, curved jaw, small, large
- pliers: combination, needle-nose, lineman's
- wrenches: crescent, pipe, adjustables, open-end, box
- hammers: claw-16 oz., ball peen, fiberglass-tipped
- center punches and cold chisels, pin punches
- Allen wrenches: standard, metric
- hacksaw
- rubber mallet
- drill bits
- assorted speed bits for metal and wood
- 1-inch wood spade bits
- 1-inch hole saws
- tap set: assorted sizes
- awl
- 1-inch wood chisels
- metal-cutting files: assorted sizes
- tweezers
- retaining ring pliers: changeable tips
- flashlights: penlights and belt-carriers
- extension cords
- bolt cutters: 18-inch and 24-inch
- drills: electric, cordless
- tape measure
- combination square
- bench vise
- wire cutters, strippers
- staple guns
- lubricants: WD-40, graphite powder, LPS-1

Standard Locksmith Tools

- key files: warded, round, pippin
- file handles
- plug followers: 0.395, 0.495, 0.500, 0.550 diameters
- plug holders
- shims
- pin tweezers
- dial caliper or key micrometer
- broken key extractors
- cylinder cap remover
- pin tray
- Truarc ring pliers
- professional lockpicking sets
- tubular lockpicks

- warded padlock picks
- key extractors
- double-sided disk tumbler lockpicks
- lockpick gun (optional)
- plug spinner
- padlock shims
- wooden strike locator
- cylinder removal tool
- pin tumbler kits: small, large, 0.005 or 0.003 increments
- interchangeable core pinning kit
- key decoder
- die stamp sets
- locksmith stamps: Master, Do Not Duplicate
- mortise cylinder lock tap and die set
- tubular lock drills
- interchangeable core pinning block
- interchangeable core capping block
- key machine (duplicator)
- key machine (code cutter)
- tubular-key key machine
- metal punch and die set
- one-way screw remover

Locksmith Automotive Tools

- car-door opening tools
- auto lock cap pliers
- door handle clip removal tool
- door panel clip removal tool
- window wedges
- GM tumbler decoder gauges
- GM lock block
- Ford ignition drill template
- lock plate compressor: tilt/telescoping
- flexible shaft probe light
- Bezel nut wrench
- door lock retainer clip removal tool
- GM plug puller
- VATS (pass-key interrogator/decoder)
- Curtis clipper (portable key punch for auto keys)
- glove compartment plug removal tool
- dust cover tools
- steering wheel pullers
- impressioning plates
- auto lock pinning kits: domestic, foreign

In addition to tools, there are a number of other materials you will have to have on hand to supply and perform basic and advanced services.

CODE LISTINGS

Every locksmith shop, and even the locksmith who works part time, needs to have general code listings. These code listings supply pinning information for pin tumbler locks, disk tumbler locks, combination locks, and lever tumbler locks. A lot of service calls require that a locksmith find and decipher codes to cut new keys. These code listings should include general codes for all types of lock cylinders, including:

- desk locks
- file cabinet locks
- automotive locks
- luggage locks
- keyed padlocks
- combination padlocks
- locker locks
- mailbox locks
- window locks
- chest locks
- cooler locking handles
- garage door locks

Code listings can be acquired from manufacturers or the industry in the form of code books, microfiche, or computer software. Traditional code books are supplied in volumed sets, and are usually separated into general code listings and listings for padlocks.

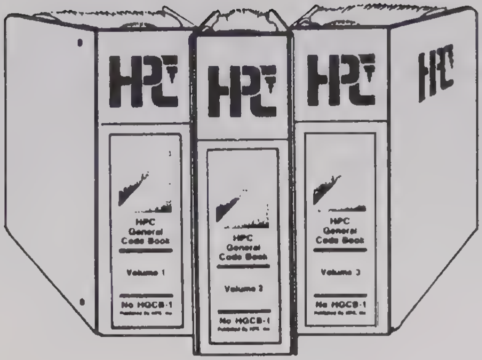
Code books

Hardcover code books are usually supplied in 10- to 12-volume sets for general code series, and 1- to 6-volume sets for padlock codes, depending on the seller. They can be purchased from trade publications, distributorships, and even manufacturers that supply codes for a particular series of their own lock cylinders.

The Reed Code System, designed and sold by The Locksmith Publishing Corporation, is one code set worth mentioning. They were the first code books developed as a reference system for locksmiths, for which expansion was planned in advance. This permits common indexing of all volumes for quick data access. They provide some of the most accurate, up-to-date code information available anywhere, and provide more codes than any other single-source system.

Code books take the guess work out of code work. Card and key guide numbers and hand cutter information are included to facilitate use of the codes with all of today's popular code cutting equipment. In addition, code books provide these valuable features and benefits (Figs. 3-38 and 3-39):

- spacing and depths data with each code series;
- codes for the most popular makes of utility and vehicle locks, and also for the more obscure series not found elsewhere, but still in circulation;
- codes are never deleted; they are continually updated;
- code series are cross-referenced to codes for similar locks designed to the same general principles;
- domestic and foreign codes are included.



3-38
A three-volume general code book set. Accredited Lock Supply Co.

3-39
A two-volume foreign car code book set. Accredited Lock Supply Co.

In addition to general code series books, specialty codes like foreign automobile locks, high-security auto locks, and motorcycle locks can be obtained in separate code books. Many of these code books also include detailed diagrams for servicing many of the covered code series.

Computerized codes

Over the past decade, computerized code series have evolved on computer disks. The advantages to computerized codes are obvious. First and foremost, shelf space is saved. A 12-volume set of hardcover code books takes up considerable space. Computerized codes free up that space for other tools, supplies, or hardware. Second, codes can be found much quicker. With just a few keystrokes, the desired code can be found. Third, computerized codes usually cost less than hardcover volumes. Most of these programs are supplied in 5¼-inch or 3½-inch disks and are IBM compatible.

TECHNICAL MANUALS

Walk into any automobile service station and you might be lucky enough to catch the auto mechanic staring at an automobile repair manual while he or she works on your car. No matter how knowledgeable and skilled you are at your craft, you will inevitably need to reference some kind of technical information. Unfortunately, the human brain is not like that of a computer. You simply cannot keep the vast amount of information you acquire in your brain's memory at all times. Thus, you will need to include technical manuals in your arsenal of tools and educational aids.

Technical manuals serve two purposes: they act as a memory bank to supply you with crucial information you might have forgotten, and at the same time remind you or teach you how to perform specialized procedures. Technical manuals are just as important for locksmiths as they are for professionals in any other craft. They keep you up-to-date and prepare you for the unexpected.

There are literally hundreds of technical manuals available to the locksmithing industry on all kinds of general and specialized subjects, such as automobile lock servicing (foreign and domestic), safe lock servicing, master keying, lock picking, alarm installing, high-security product applications, and more. Technical manuals let you learn about almost any locksmithing topic in the privacy of your own home. They are also excellent take-along tools to have in your service van or car.

THE HOME WORKSHOP

A home workshop might not be considered a tool by some people. However, its usage, availability, and layout can mean the difference between a comfortable work environment and one that impedes your ability to learn and perform successfully. Your workshop might become one of the most important tools you ever use.

You will need a place to pin locks, cut keys, rekey locks, and perform other general shop work. When you begin, you probably will require a small amount of space to store tools, supplies, and other materials. Many locksmiths initially supply services from a basement, attic, or garage shop. Even a small, unused room in your home or apartment can be a suitable work area. A safe, comfortable, and enjoyable workshop should contain the following:

- safe electrical management
- proper lighting
- heating and cooling appliances
- ventilation
- soundproofing
- a quick exit
- fire-fighting equipment
- proper flooring
- safety equipment

Safe electrical management

Utilizing an existing electrical outlet within the shop, tapping into a nearby circuit, or even planning to add new circuits should be done carefully and with the assistance of a qualified electrician. You want to be sure that the power you draw will not overload the shop's circuit(s) or any other circuits in the house. It might be wise to discuss with your electrician the addition of a smaller, auxiliary service panel (subpanel) in order to completely separate your shop from your home's main panel. In addition to maintaining safe amperage draw, you should also plan to install overhead and floor outlets, multi-outlet electrical strips, and ground fault interrupters

(GFIs) where necessary. GFIs not only protect the main and subpanel, but also your power equipment.

Proper lighting

Proper lighting is vital. Fluorescent fixtures are best because they supply wide, shadowless, direct overhead light, use less electricity, and have bulbs that last longer and generate less heat. Also plan for movable fixtures that can be plugged safely into outlets around the shop.

Heating and cooling needs

Heating requirements might include an existing radiator, an electric baseboard heater, a plug-in space heater, hot-air-duct, or even a wood stove. An existing heating element might or might not be convenient depending on how the shop is laid out. Keep in mind, though, that electric plug-in heaters use considerably more electricity, and quickly generate heat.

For cooling, you might use either a window-installed fan or an existing central air conditioning system. Most basements stay cooler in the summer than the rest of the house, therefore, your cooling requirements shouldn't be as much of a concern as your heating requirements, unless you plan to put your shop in the attic.

Ventilation

Ventilation is important in a locksmith home workshop. Fumes from some locksmithing lubricants are under pressure, are extremely irritating, flammable, and contain petroleum distillates. If no ventilation exists (like a window) plan to install an exhaust fan in the ceiling or in one of the outside walls.

Soundproofing

Soundproofing should be of some concern, since noise and vibrations from key machines, electric drills, and hammer-banging can be extremely irritating to the rest of the household. Besides protecting your own hearing, plan to install special soundproofing tiles on the ceiling, or to install soundbatt insulation or soundproofing wallboard between the shop and adjoining rooms. To reduce noise vibrations, place rubber, cork, or felt pads under key machines or any other power equipment that vibrates.

Fire-fighting equipment

If you think a fire can't start in a locksmith shop, think again. Locksmith lubricants, cleaners, tool sparks, smoking, and electrical shorts can start and spread a fire without warning, either from carelessness, accidents, or other means. For these reasons, fire-fighting equipment should be readily available. This equipment should include smoke detectors and fire extinguishers. Use at least a 5-pound, Type-ABC extinguisher that is capable of putting out all types of fires, including oil, grease, wood, other combustibles, and electric.

Flooring

A workshop floor should be skid-proof, dry, and comfortable to stand on. Most basement shops already have a concrete or resilient tile floor. The main thing to be concerned about is that your workshop floor can be cleaned easily should accidental spills occur. Also, consider placing a rubber mat in front of workbenches to ease the strain on your feet. If you use computer equipment, make sure the floor mats you use will protect your computer equipment from static discharges.

Safety steps and equipment

To protect yourself and others who might wander into or work in your shop, make sure you have the proper equipment to protect your face, hands, ears, head, and eyes. Face shields, safety eye goggles, gloves, ear protectors, and first aid equipment should be present and utilized at all times. In addition, wear proper clothing. Wear work shoes with steel caps to protect your toes from falling objects like chisels, hammers, and portable power tools. A respirator is a good investment. Use it to protect your lungs and nasal passages from mists, lubricants, and irritants such as key dust from key machines.

Don't wear hand jewelry, neck chains, ties, or other clothing and ornaments that might get tangled in key machines or other power tools. Keep all flammable liquids

Foley Belsaw

3-40 A small, home workshop.

in cans in metal cabinets, and routinely dispose of all waste material before it has a chance to build up and create a fire hazard. Remember: **safety comes first!**

The layout of a home shop

Although much that is discussed about a home shop also applies to full-blown commercial store fronts, there is one thing that separates the two: the availability of space. With a home shop, you will have to condense a lot of tools and supplies into a very small area. But with careful planning and by eliminating the frivolous, you can design and outfit your first shop economically and practically.

Only a small amount of space is required. Figure 3-40 shows a small, home shop that is separated from the rest of the house. An L-shaped worktable was built around two of the walls and supplies two shelves: one is a working table top and one is for storing tools and supplies. Above the work table on one wall is a pegboard that is used to hang keys and lock supplies. The worktop table is also used for small hand tools, pinning kits, and key machines. You can get the most out of your shop by carefully planning ahead. Sometimes, a drawn blueprint or sketch can help you plan out the shop beforehand.

4

Securing employment

Fortunately, finding a job in the locksmith industry is not difficult. Locks and keys and other security products are used daily by millions of Americans, which creates a constant need for beginning and experienced locksmiths. Most lock shops, whether large or small, are owned and operated by independent business men and women, which enables shop owners to hire at random. But approaching a shop owner is not the only way to secure employment. Because this field is progressing rapidly, a beginner and even the experienced locksmith has more than one avenue to pursue.

CLASSIFIED ADS

In almost every newspaper, almost every day, there are employment ads for locksmiths. Most of these ads are placed by private shop owners, major corporations, hospitals, schools, and even utility companies. If you find out the skills these employers want before you respond to the advertisement, it will be easier for you to get the job, or at least an interview. The following is an example of a typical locksmith ad in a daily, New York City newspaper:

> **LOCKSMITH** needed (2). Must have five years experience in automobile, safe, and general lock work.

This ad holds little hope for the beginning locksmith. Because a shop owner could spend most of the day talking on the phone to prospective employees, the ad states that interested parties must have at least some general knowledge of locksmithing. Most of the ads you see will call for experienced locksmiths only.

But don't let this cold, very real fact discourage you. After all, you are not just anybody. You have some formal, basic locksmithing training. Let's look at how you might introduce yourself to this shop owner who obviously needs help.

Responding over the phone

If you choose to respond by phone to a newspaper ad, have your personal information ready before you make the call. Treat it like an in-person interview situation.

Most shop owners will ask a few basic questions before they arrange an interview. Initial questions might include:

- How many years experience do you have?
- In what areas of locksmithing are you experienced?
- Where were you educated?
- For whom have you worked in the past?
- Do you have a work vehicle?

Don't expect to discuss the salary over the phone. Most shop owners will have you fill out an employment application that asks you to write down your salary requirements. Your salary requirements are better left to the end after you are offered the job. Then you can negotiate the amount of your weekly paycheck. If an employer wants to talk about salary requirements and not much else, look elsewhere. That is a clue that the shop owner is only interested in hiring cheap labor.

The best way to respond over the phone is with a short, informative reply, like the following: "Hello, I'm calling in reference to the locksmith job that you advertised in today's paper."

Let the shop owner do most of the talking. Answer only the questions asked of you. Do not volunteer any additional information, unless you feel that it will increase your chances of landing the job. The reason for responding to the ad with a phone call is to find out if the job is still available, and if it is, to get an interview.

Don't walk into someone's shop without an appointment and expect to talk about the job. Locksmith shops are extremely busy places, especially those run by one or two people. Not only will this tactic make you appear rude and inconsiderate, it probably will not help your chances of getting the job.

Interviewing

Once you are invited for an interview, take the time to prepare yourself, even if some shop owners want to see you immediately. Use common sense. Interviewing for a locksmith job is no different than interviewing for any other type of job. Dress neatly, and appear well-groomed, alert, and appropriately confident. Be on time. It might not hurt to be a few minutes early. Announce yourself when you arrive, unless the person or persons at the counter are so swamped with customers they will view your arrival as an intrusion. If that is the case, then wait until the craziness has calmed down. Walk around the store and notice how things are displayed, the appearance of the shop, etc. This will tell you a lot about your prospective boss.

Once you meet the person who will be interviewing you, answer each question quickly and honestly. Do not, under any circumstances, tell the shop owner that you can do almost anything. Some shops specialize in auto work, some in safe work, others in master keying, or in other areas of locksmithing. Raising expectations about your skills will not help either one of you later on should you land the job.

When you fill out the application form, list all of your previous employers. If you haven't worked for anyone, it might be a good idea to inform the shop owner of that immediately. Sometimes shop owners are so desperate for help, they will hire an apprentice. Be sure to list your educational experience, including the school you attended or what correspondence course you completed. Bring along and show them all of your certifications, diplomas, and licenses to prove you have at least had basic locksmith training.

For an interview to be effective, you must convince the shop owner to hire you and you must also know what you require of the job, such as insurance coverage, vacation time, sick leave, and/or compensation for gas and repairs if you are required to use your own vehicle for service calls. Many small shops, especially those run by one or two people, might not be able to offer you many benefits. You will have to decide if you can accept the terms of the position. But keep in mind that if you need job experience, you might want to accept the job and then look for something better in six months or a year.

Some tips

If the shop owner likes you, but seems reluctant to hire an apprentice, suggest that you be hired for a short probationary period, such as two months. Tell the owner that if within that period your performance is unsatisfactory, then you agree to the termination of your employment with no hard feelings.

Another good tactic is to suggest part-time employment in the beginning. This will give the shop owner a chance to test your skills without making a full-time commitment. If you agree to work on weekends, evenings, or part-time during the week you might increase your chances of being hired.

TRADE PUBLICATIONS

Most locksmith trade magazines publish employment classified ads. While many of these ads are from locksmith shops seeking help, others are placed by lock and safe equipment manufacturers looking for company representatives. Others list shops and established businesses for sale. Here are two ads that recently appeared in one of the industry's leading magazines.

> Experienced Locksmith Wanted. Relocate to beautiful southwest Florida and work in a friendly and progressive atmosphere. We provide medical insurance and paid vacation. Send resume or call: John Koons Locksmiths Phone: XXX-XXXX
>
> Experienced Locksmith Wanted. To fill immediate full-time position in Boulder, CO. Minimum 2-years experience in automotive, residential, commercial. Competitive pay and benefits. Send resume or call: Kaiser Lock & Key Phone: XXX-XXXX

RESUMES

You will notice that both of the trade magazine ads requested resumes. Resumes for professional locksmiths are just as important as for any other profession. Companies that advertise extensively for locksmiths examine and check resume information before they call applicants for an interview. A properly prepared resume tells the prospective employer that you are serious about getting a job, and that you are organized and literate. A professional resume will increase your chances of being called for an interview.

Send copies of your resume to local lock shops, manufacturers, and distributorships for which you would like to work. Sometimes just calling attention to yourself might unexpectedly land you a job. Many distributors hire locksmiths to work at their counters or inside their shipping warehouses. Manufacturers hire locksmiths as company representatives and as training instructors.

SALARIES

Locksmith salaries are dependent on an employee's experience and how much a shop owner can afford to pay. Small shops with only one or two employees usually cannot afford to pay as much as shops with six, eight, or more employees. Also, shops in larger cities will pay considerably more than shops located in rural areas. Base your expectations on the average locksmith salary for the area in which you live, the benefits you are receiving, and your work hours.

For instance, a locksmith who receives good health benefits, paid vacations, and a fair amount of personal days, probably will not be paid as much on an hourly basis as one who receives none of these benefits. It takes a tremendous increase in your per-hour pay rate to make up for a good benefit plan.

Experience is also a consideration. An apprentice locksmith will probably be offered a salary equivalent to 60 to 75 percent of that of an experienced locksmith. A fair shop owner, however, will promise quarterly or bi-quarterly raises in return for hard work and evidence that the apprentice's skills are growing.

Some shops work on a commission basis. That means you collect a percentage of the payment for every job you do. Some shops work this way because they feel that an employee who works on commission will work faster and harder. Many night-time jobs are based on this principle. If you agree to perform a shop's night-time emergency work, then you will probably earn a percentage of the job, usually from 50 to 65 percent.

WORKING HOURS

The typical locksmith starts work at 8 or 9 A.M. and works until 5 or 6 P.M. Many shops require that you work six days a week, and holidays. When you go on a job interview, make sure you reach an agreement on what days you can and cannot work, and on what holidays you will and will not work. Also be aware that many shop owners will send you out on a job 15 minutes before you are supposed to go home. Make arrangements for how you will be compensated for the overtime. A shop owner who expects you to work for an extra half hour every night in order to complete a job, and refuses to pay you extra for it, should not be on your high-priority list of employers.

INSTITUTIONAL LOCKSMITHING

Many colleges, office buildings, maintenance companies, city administrations, hospitals, schools, and other places of business hire their own in-house locksmiths. Their reasons for doing so are based on sound business strategy and convenience. Having to hire a locksmith every time an office door lockout occurs, a repair needs to made, or a lock to a massive master-key system needs to be rekeyed can be quite expensive. For that reason, institutional locksmithing has quickly grown over the last decade. Locksmiths who work for institutions, however, must be as experienced and versatile as locksmiths who work for private shops.

Most office, school, and city buildings today are protected by a variety of security devices. Therefore, a locksmith who applies for a job at an institution should be up to par on all phases of locksmithing, including:

- electronic access control devices
- extensive master-key systems
- safes
- alarm systems
- door closers
- a variety of different locks

The benefits to working for a private institution can be tenfold those of working for a private shop. Institutions usually offer better wages, better benefits, longer paid vacations, more sick and personal days, bonuses, 401(k) plans, pensions, and other in-house or employee benefits. Some institutional locksmiths automatically become members of unions, thus reaping the associated rewards and benefits. Another advantage is education. Many companies realize that for their locksmiths to keep up with modern technology and remain versatile, they have to pay for continuing education, including seminars, technical manuals, and manufacturer-sponsored training.

5

Finding your niche

As in any industry, the locksmith profession is comprised of specialty areas with which a locksmith can choose to become involved. Although a locksmith must remain as versatile as possible, becoming an expert in one or more specialty areas can be advantageous. Not only will it make finding a job easier, but it will also help you build your reputation, which in turn should cause your business to flourish.

Specialty areas, however, require special tools, supplies, and skills. For each of the areas covered in this chapter, I have supplied a list of tools and a discussion of the types of jobs that a locksmith might be expected to perform. Some of the major specialty skill areas are:

- automotive lock work
- safe and vault work
- safe deposit box work
- electronic access control
- burglar and fire alarm systems
- automotive alarm systems

AUTOMOTIVE LOCK WORK

Automotive locksmithing has become one of the biggest specialty areas in the last decade, and one of the most profitable. This is due to the rapid technological advancements in vehicle locks and vehicle antitheft devices in general. Many shops specialize exclusively in the repairing and rekeying of automobile locks. Vandalized locks, ripped out door, trunk, and ignition locks, and broken, stolen, and lost car keys account for most automotive lock work.

Automotive alarms and wheel and tire locks also account for quite a bit of work. Many domestic and foreign models are now equipped with ignition antitheft systems, airbags, and keys that most local hardware stores, body shops, and auto repair centers are not prepared or qualified to service or duplicate. A knowledgeable automotive locksmith usually can make more money than a locksmith who does no automotive lock work.

Before you decide to become an auto lock specialist, there are a few things you should know about modern automotive lock work. Due to the sophistication of some auto locks and ignition systems, these jobs require extensive technical training, tools, and supplies. The liability factor is also high. Many cars, especially domestic models, are now fitted with computerized antitheft ignition systems and airbags. Because of the damage that can be done to these cars while they are being serviced, and the cost of the subsequent repairs, auto locksmiths must be well trained.

To be able to perform all kinds of automotive work, like opening locked car doors, making keys for ignitions, replacing and rekeying door and trunk locks, installing car alarms, and servicing cars with wheel locks, the following tools and supplies are necessary.

- steering wheel pullers
- lock plate compressors
- screwdrivers/varied
- nut drivers
- wrenches: combination, varied
- socket sets
- adjustable wrench
- snap–ring pliers
- pliers: varied assortment
- hammers
- punches
- electric drill
- cordless drill
- drill bits: varied assortment
- lock picks: standard
- wafer/double-sided lock picks
- key files
- door window clip removal tool
- ***Briggs & Stratton Auto Service Manual***, AS1975
- varied auto lock service manuals
- automotive code listings
- liquid solder
- cylinder retaining pins
- auto key catalogs
- auto key blanks
- VATS decoder/interrogater
- automotive pin kits
- automotive lock-out tools
- multimeter
- electrical tape/connectors, etc.
- soldering gun
- wire solder
- lock replacement parts
- car-door opening tool light
- torque wrench
- dremel tool
- staking fixture

On any given day, a locksmith might be called to perform a variety of automotive lock work. For instance, many people lock their keys in their cars. Some of these people call the police, some call a service station, and some call a locksmith. Many motorists have learned the hard way that the only person who should be called to open a locked car door is a locksmith. Locksmiths are the only professionals properly trained in the operation and repair of car door locks, trunk and ignition locks, and the linkage systems inside the door panels that connect these locks to the door latches, door handles, and lock/unlock mechanisms. Individuals who know nothing about automotive locks can damage these parts inside a door panel.

It is extremely important that you have the proper car door opening tools. Long gone are the days when the basic slim-jim was enough to open almost any vehicle door. Today, many cars are manufactured with sophisticated lock-linkage systems that thwart auto thieves. Fortunately, there are a varied amount of car door opening tools manufactured specifically for the locksmith.

Before you choose the car opening tools you will use, thoroughly research the tools available. While one set might or might not be superior to another, the most important factor is that you are comfortable using the tools and understand the operating instructions. Also consider how much is covered by the tools, their costs, and whether or not yearly updates are made available by the manufacturer.

SAFE AND VAULT WORK

Safe and vault work is one of the most respected areas of locksmithing. To qualify as a safe and vault technician, a locksmith must have a tremendous amount of skill and knowledge. There are also many tools and supplies needed to perform this type of work. The typical safe and vault technician will perform the following services on a daily basis:

- drill open safes with lost combinations
- drill safes that are not working properly
- manipulate open safe locks
- service and repair safe locks
- sell and install wall, floor, and free-standing safes
- change safe lock combinations
- service time locks
- service bank vaults
- service safe deposit boxes
- service government security containers

Most of these skills will come with experience and from working beside experienced technicians. Currently, there are only a handful of schools and correspondence courses that teach safe and vault skills at a respectable level. Lockmasters Professional School in Nicholasville, KY, is the leader in safe and vault education. Should you decide to involve yourself in this type of work, I suggest that you contact Lockmasters and receive their course information. Another well-respected organization is the Safe and Vault Technology Association, also in Nicholasville, KY.

The following is a list of tools and supplies that you might need to perform safe and vault work. As your skills and knowledge grow, many more tools might be needed.

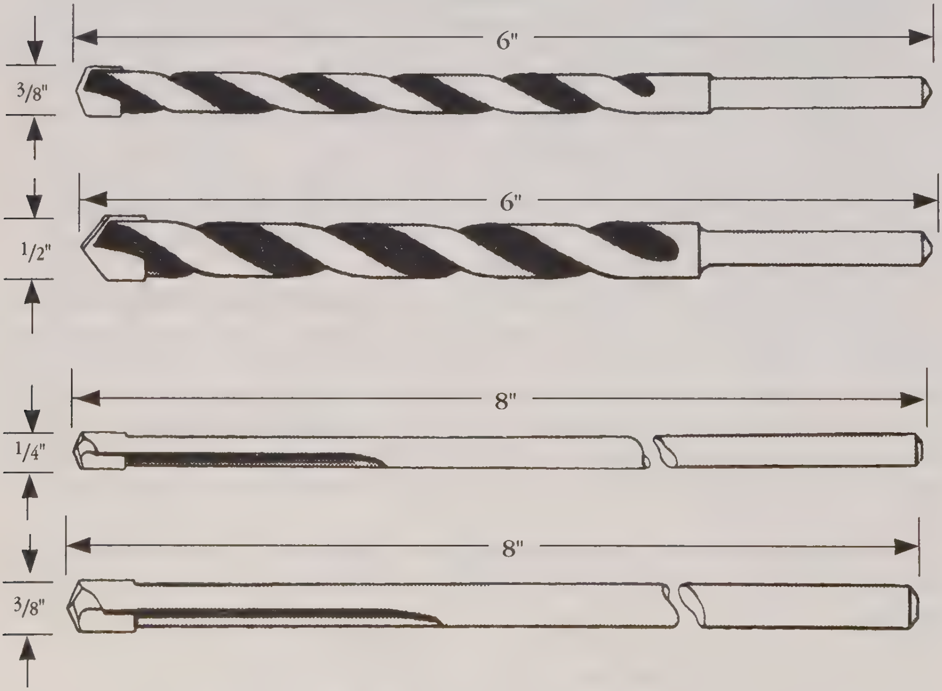
- emergency safe dials
- alligator forceps
- punches
- safe-dial pullers
- dead blow hammer
- spline key punch
- amplifiers
- ball bearings (for repairs)

- safe lock change keys
- cut-away locks
- fire-safe insulation
- humidity indicator card
- lacquer sticks
- lubricants
- flexible lights
- safe lock mount
- safe opening tools
- safe pluggers
- safe repair kit
- silica gel
- skip pick
- Spirolox insertion tool
- spline keys
- tap and die sets
- torque measurement kit
- manipulation books
- manipulation data books
- safe drilling templates
- penetration drill and rig
- hardplate drill bits
- hardplate hole saws

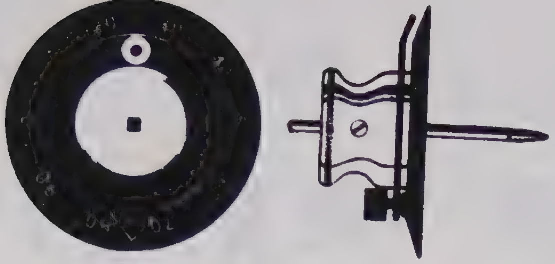
Figures 5-1 through 5-3 show a few tools used for emergency safe lock work.

SAFE DEPOSIT BOX WORK

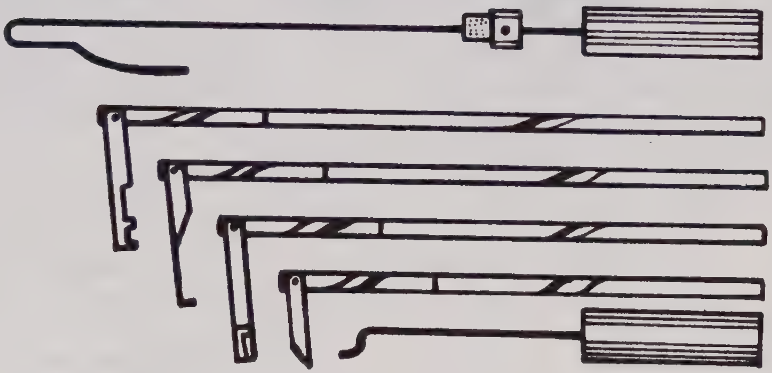
An estimated 60 million safe deposit box locks are in the United States, with more than 800,000 manufactured every year. Properly trained technicians can expect to find numerous job opportunities, especially if they plan to work in commercial areas. Safe deposit box locks are found in banks, hotels, and post offices. Banks offer good contracts to shop owners who can meet their service needs. Every time a safety deposit box renter loses a key, a lock malfunctions, or the boxes need to be rotated, a locksmith is called.



5-1 Carbide-tipped drill bits for drilling through hardplate. Accredited Lock Supply Co.



5-2
An emergency dial for safe locks that have been vandalized.
Accredited Lock Supply Co.



5-3 Emergency safe opening tools. Accredited Lock Supply Co.

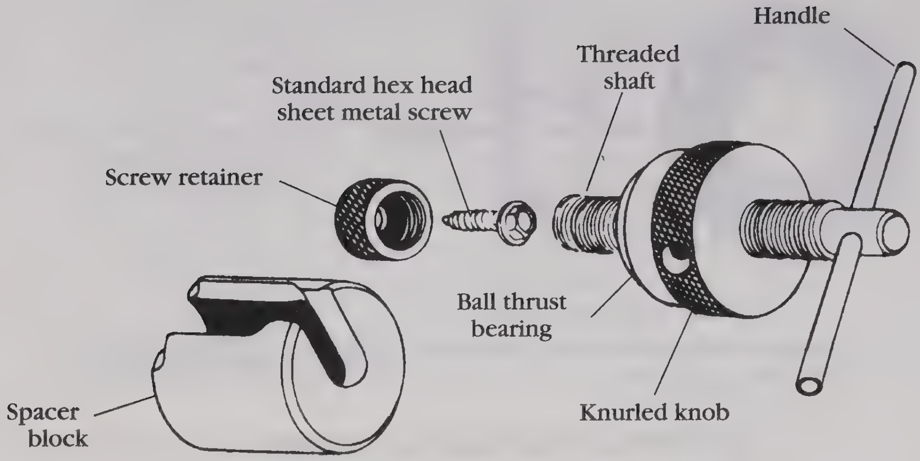
As in safe and vault work, safe deposit box work demands extensive technical training and specialty tools. To be able to work with safe deposit boxes, you need to understand the operating characteristics and specifications of lever locks. You will need to learn how to change tumblers, to pick lever locks, pull noses and safety deposit box doors (Figs. 5-4 and 5-5), change and install locks, and the different methods used to cut safe deposit box keys. You will need a safe deposit box key duplicating machine and these specialty tools:

- warding file
- taper pins
- neutralization kit
- door puller kit
- key stamps
- hand stamps
- safe deposit lock change keys
- key wallets
- space and depth keys
- technical manuals
- manufacturer catalogs
- nose puller
- safe deposit box locking key envelopes
- reamer

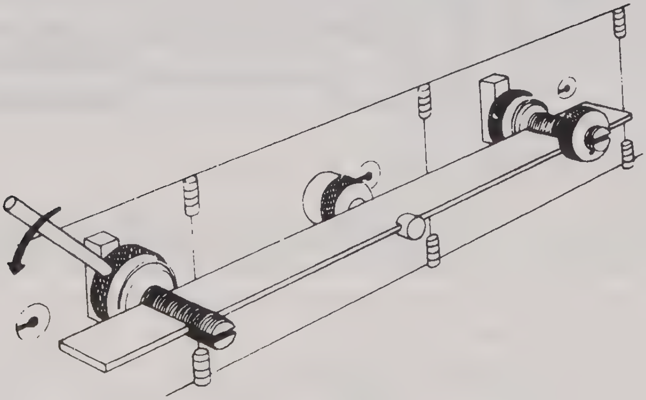
The best source for education in this area is, once again, Lockmasters Professional School in Nicholasville, KY.

BURGLAR/FIRE AND AUTOMOTIVE ALARM SYSTEMS

More and more locksmiths are performing alarm work. This lucrative part of the security business can mean increased profits and even monthly recurring service fees.



5-4 Nose puller for safe deposit boxes. Accredited Lock Supply Co.



5-5 Door puller set for safe deposit boxes. Accredited Lock Supply Co.

The technological advancements in automotive alarms and in wireless burglar/fire alarm systems have made these installations less time-consuming and technical. Another attractive factor is that the financial investment for tools and supplies is minimal.

There are two important steps you must take if you want to become involved in alarm work. First, you must check the current laws that dictate who can and who cannot commercially install alarms. Some states require that anyone selling or installing alarm systems to the public or to commercial establishments be state or city licensed, certified, and/or possess an electrical license. This might mean you will have to enter a state-sponsored or approved training program. Some states do not have these laws, but it would be wise to check with your local associations before you spend money on tools or training courses.

Second, you should learn as much as possible about the basics of alarm theory, operation, and installation. Only when you know the electrical and operational specifics of alarm system components and how everything is installed and serviced, can you safely begin to do work for customers. One excellent training source is the National Burglar and Fire Alarm Association (NBFAA). The NBFAA is a nationwide association that offers training courses in basic and advanced alarm theory.

You will need a varied assortment of alarm installation tools to be able to get all that alarm transmission wire through walls, ceilings, and floors. Other equipment enables you to test and troubleshoot problem systems. (For a more extensive discussion on alarm systems see chapter 17.)

- basic hand tools
- cordless and electric drills
- flexible drill bits
- wire-pulling tools
- analog or digital multitester
- jumper cables
- soldering iron: 100 to 140 watts
- solder
- centering tools to align recessed magnets
- staples
- shrink/heat wrap
- staple guns
- electrical tape
- number labels
- cable ties
- wire clamps
- grounding clamps
- terminal strips
- RTV-type mounting compound
- foil
- foil repair tools
- wire crimpers
- wire strippers

Some technicians specialize in one area of alarm work. For instance, one person might decide to do only installations. An installer runs alarm transmission wire through doors, walls, ceilings, floors, etc., and might even do the actual wire hookup to the control panel. Many alarm companies leave the programming of the alarm system to technicians who never leave the shop. Computer downloading/uploading from a remote terminal in the alarm company's office usually serves as the vital link between the on-site system and the company. This alleviates installer on-site time. Some technicians troubleshoot systems, which means they are sent out to track down and repair shorts, opens, and other electrical problems within a system that might cause false alarms or improper operation.

Many locksmith shops work with alarm installing companies. Some locksmith shops sell the job, then hire professional alarm installers to do the actual on-site installation. Some companies work strictly on a finder's fee basis. Many alarm companies pay a commission to locksmiths who find them work. There is more than one way for a locksmith to enter this lucrative field. Talk to alarm installing companies and their salespeople to find out how you can become involved.

ELECTRONIC ACCESS CONTROL

Electronic access control has become one of the largest specialty areas within the security industry in the last decade. The popularity of electric strikes, intercoms, electric locks, keypad activated systems, electromagnetic locks, and card-access systems has translated into increased commercial sales. Ironically, many of these products are simple to install, service, and operate. Locksmiths who are involved in the electronic access market have found it to be a lucrative field.

6

Obtaining advanced certification

Whether you are an apprentice locksmith or a licensed or certified locksmith, there might come a time when you desire a professional industry rating next to your name. Such a rating might make it easier for you to find employment, land more jobs for your own business, and earn you greater respect from your peers. Such a rating needs to be earned, just like a locksmith license needs to be earned.

How do you reach this higher standard of excellence? You might attend locksmith schools, take correspondence courses, attend seminars, read all available technical information and articles, attend association meetings and seminars, and learn from your own experience. When you have done all this, you can take the tests issued by the Associated Locksmiths of America (ALOA). ALOA offers the only industry-recognized certification programs: Certified Registered Locksmith (CRL), Certified Professional Locksmith (CPL), and Certified Master Locksmith (CML). These certifications confirm that you have passed the required written exams as set forth by ALOA.

To be able to take these exams, you must be a member of ALOA. To be a member, you must pay an initial membership fee, annual dues, and prove that you are an employed locksmith or an apprentice in the industry. Sponsorship from within the industry might also be required.

THE PROFICIENCY REGISTRATION PROGRAM

ALOA's examination program is called the Proficiency Registration Program (PRP). Testing is done at local locksmith conventions. The PRP consists of a 10-part mandatory test and 36 elective categories, taken at three levels. The mandatory test consists of basic locksmithing skills and techniques. Locksmiths wishing to take the exam should be proficient in these basic areas:

Code and code equipment

Understand and know how to use key codes, methods of originating keys by code, code book structure, be able to identify the most common codes for a specific manufacturer, and how best to generate a key for an unknown code origin.

Identification of key blanks

All locksmiths, whether apprentice or experienced, should be able to identify key blanks by bow shape, blade milling, tip profiles, and cylinder broachings. They should also be able to recognize and identify key-section drawings that are placed under each key blank in general key-blank manufacturer's catalogs. A good way for an apprentice locksmith to become familiar with the most common key blanks is to examine all the key blanks included in the most popular key-blank sets sold by the major key-blank (after-market) manufacturers. These sets are comprised of the top seller blanks and most used lock-key sections.

Duplicating, impressioning, and cutting keys by code

Locksmiths must know how to duplicate keys by using a key file, impressioning techniques, cutting keys by code from information derived from the lock's housing or face of the cylinder, or from a customer's supplied record. It is important to have a working knowledge of code-book listings and the ability to operate key machines. This book does not discuss how to use code books, code machines, interpret code stampings on key blanks and lock cylinders, or how to fit a key to a lock with an unknown key code. This precaution has been taken to protect the security of the general public. This type of information and education is supplied by the industry to certified, licensed, and valid apprentice locksmiths.

Servicing pin and disk tumbler cylinders

Pin tumbler and disk tumbler cylinders are the two most common types of lock cylinders in use today. All locksmiths should know the basic parts and the operational theory of these cylinders. They should also be able to troubleshoot and repair lock and lock cylinder operational problems that stem from poor pinning methods, poor key duplication and key duplication generation errors, usage wear, weather effects, improper customer usage, and any other condition that might arise. All locksmiths should be familiar with the operational mechanics of key-in-knob locks, mortise locks, tubular deadbolts, rim locks, general desk, locker, and other locks that utilize pin and wafer tumbler cylinders.

Emergency lock opening techniques

This is a basic locksmith service and should include these skills: lock picking, cylinder bypass methods, shimming, impressioning, drilling (either at the plug shearline or the cylinder retaining screws) lock face plate, and general bypass route manipulation holes from the general vicinity of the lock body on the surface of the door (readily repairable), forced methods of security plate and cylinder security collar removal, and cylinder key raking. Every locksmith, whether apprentice or professional, should learn the skills and techniques needed to circumvent locks, whether standard, high-security, or supplied with auxiliary security hardware. The public expects any locksmith to be able to open a lock using whatever means necessary when the key to that lock is lost or unavailable.

Locksets and lockset functions

Lockset functions should be basic knowledge for all locksmiths. There is no reason why an experienced locksmith should not be able to view and then quickly ascertain the functions that a lockset should perform. Study and memorize the various manufacturer-supplied jamb and door preps and lock finish and description codes (ANSI/BHMA). This information is readily available from all manufacturers' product catalogs. Although some descriptions might vary from manufacturer to manufacturer, a general understanding is warranted. This subject can be extremely important because you must comply with life safety codes and the Americans with Disabilities Act.

Servicing of locksets

All locksmiths should understand the installation, removal, and general repair of all lockset parts and functions, including key-in-knob locks, mortise locks, rim locks, deadbolts, etc.

Basic master keying

Skills in this area should include progression theory, pinning, key coding, and the various levels of master keying. You should also know how to choose a particular method and how to design, record, and set up an entire system, as well as make provisions for future expansion.

To obtain a CRL rating, you must pass the mandatory section plus 2 chosen electives. To obtain a CPL rating, the next highest level, you must pass exams in an additional 12 elective categories. To receive the highest rating, CML, you must pass exams in 33 of the 36 elective categories. The elective categories deal with more advanced and specialized areas of locksmithing. Some of these areas are:

- advanced master keying
- alarms
- automotive: domestic, foreign
- door closers
- life safety codes
- high-security locks
- interchangeable cores
- basic electricity
- electro-mechanical devices
- detention locks
- safe installation
- time locks

To obtain additional information about ALOA and the PRP test, contact ALOA directly. The Association's address and telephone number are listed in appendix B.

OTHER CERTIFICATION PROGRAMS

Locksmiths interested in the basic and advanced alarm field can take courses and tests offered by the National Burglar and Fire Alarm Association (NBFAA). These programs award applicants either a Certified Level One or Level Two rating when satisfactorily completed. Level One covers basic alarm theory and operation. Level Two covers the more advanced operations of burglar and fire alarm systems. Many states require that new commercial alarm technicians complete the Level One and Level Two requirements. For more information, contact the NBFAA. Their address and telephone number are listed in appendix B.

7

General locksmith law

Local, city, and state laws dictate what you can and cannot do as a locksmith. It is important that every locksmith be informed of and keep up to date with the licensing and certification requirements for the regions within which they reside and work. But that is not all. Equally important is that you understand the legal ramifications that might beset you should you enter into a contract or service agreement that might be considered illegal under those laws. Be aware of proposed changes to the laws pertaining to your jurisdiction, and to the industry, and you will have a better idea of how your business might be affected in the future.

10 POINTS OF LEGAL ADVICE

These 10 points of general legal advice have been suggested in the past by the locksmith industry. Keep these suggestions in mind as you decide whether or not to proceed with a particular service or installation. This is not legal advice. When in doubt, contact your lawyer or local licensing and law enforcement officials for additional information.

#1. Put everything in writing

Draft every order, receipt, and agreement yourself. Use simple, straightforward English. (Have a lawyer draw up an agreement for you if a considerable amount of money is involved.) File and keep everything. Use common sense when you file. If a transaction involves making master keys for Mr. Bob Jones, file the work order under J with a cross reference filed under M. Any filing arrangement you devise that enables you to lay your hands promptly on the records of past transactions is all right, so long as you avoid the W.C. Fields roller-top desk technique.

#2. Buy the fire codes

Most fire codes can be purchased from the National Fire Protection Association. A prospective customer might come to you and tell you that his or her commercial premises have been broken into via a certain rear door and that he or she wants you to install a particular type of lock on that door. A quick reference to the appropriate fire code will tell you if you legally can affix that type of lock to that type of door.

#3. Do not return a serviced item until you are paid

As long as you retain the property, you have a lien on that property. You are legally entitled to retain such property until you are paid. If you return the property to the customer before you are paid, you lose your lien. If the customer fails, refuses, or neglects to pay you, or does not call for his or her property, you can eventually sell the property to satisfy your charges once you have followed the pertinent laws that allow you do to so. Consult your attorney to make sure you are within your legal rights before selling a client's property.

#4. You may not remove an installed lock

Once you install a lock, you cannot remove the lock if the customer does not pay you. This is because the lock, once affixed to the building door, becomes the real property of the owner. Removal of the lock would constitute the torts (private wrongs) and crimes of trespass and conversion.

#5. Verify ownership

Be cautious if you think the person presenting you with a lock is not the rightful owner. If you work on a lock in a person's shop, you have the right to assume that your customer is the owner of the machine, unless there are sufficient, suspicious circumstances that put you on notice that the customer lacks the authority to give you the order or that the machine is stolen property. You cannot assume that locks brought into your shop for service belong to the customer. Demand to see the customer's identification and, if at all possible, some indicia of ownership. If you fail to take proper and necessary precautions you might find yourself amenable to criminal prosecution for conspiracy or receiving stolen goods.

#6. You may refuse service

If you are requested or even ordered by a law enforcement officer to perform locksmith services you have the right to refuse and you are not obliged to give any reason for your refusal.

#7. Hire expert help

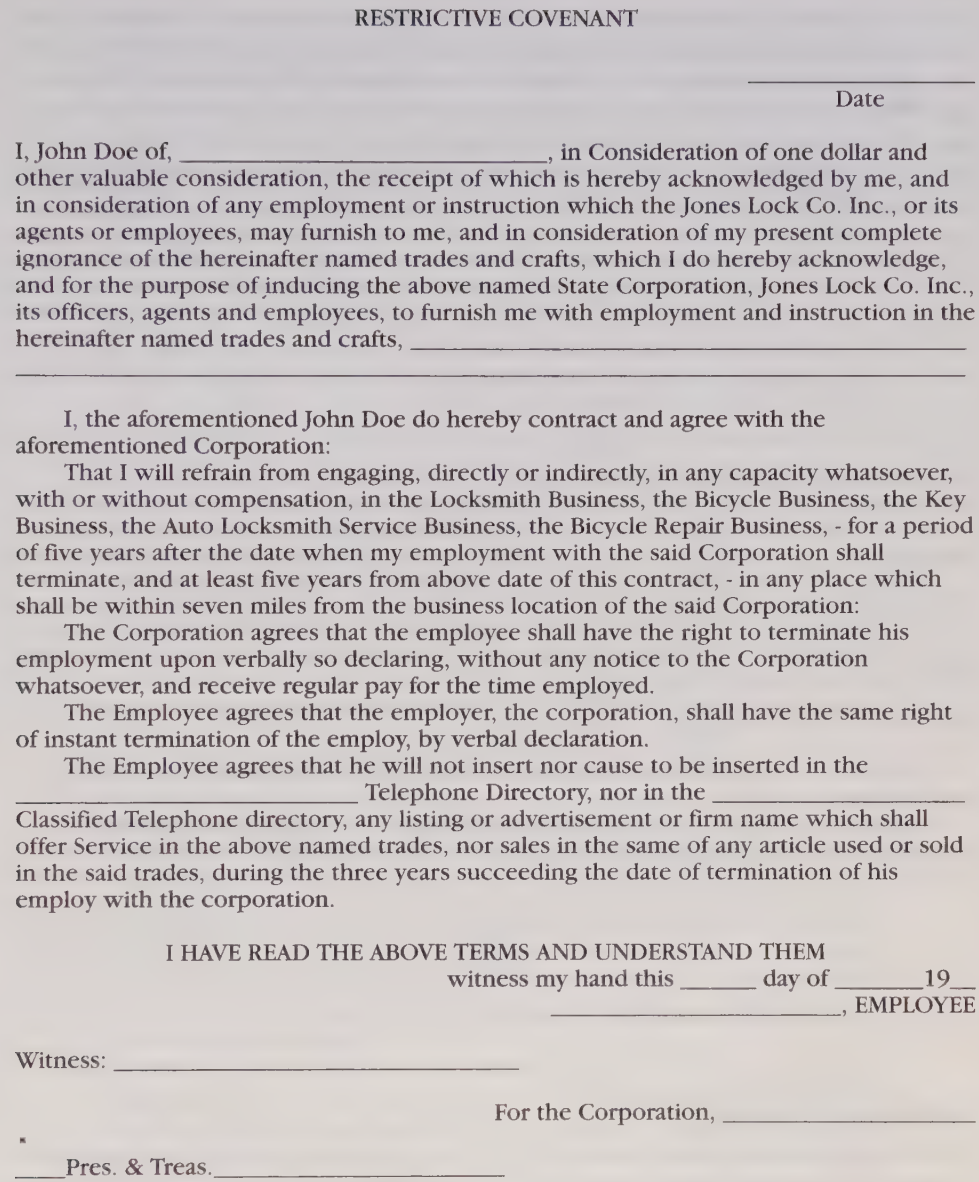
If you become involved in litigation, either as a plaintiff or defendant, and a substantial amount of money is at issue, it is imperative that you win. One of the most important steps you can take is to engage an expert witness on locks and all manner of security devices to testify either in person or by deposition on your behalf.

#8. Have employees sign a restrictive covenant agreement

For your protection have all employees sign a restrictive covenant agreement whereby they agree that upon leaving your employ they will not open their own locksmith business for a certain length of time and within a certain distance from your business premises. The time and distance restrictions must be reasonable or they will not hold up in court if challenged (see Fig. 7-1).

#9. Participate in professional organizations

Be an active member of your local locksmith organization. You can upgrade your profession and achieve greater esteem and prestige for yourself by actively participating in the programs of your local association.



RESTRICTIVE COVENANT

____
Date

I, John Doe of, ____________________________, in Consideration of one dollar and other valuable consideration, the receipt of which is hereby acknowledged by me, and in consideration of any employment or instruction which the Jones Lock Co. Inc., or its agents or employees, may furnish to me, and in consideration of my present complete ignorance of the hereinafter named trades and crafts, which I do hereby acknowledge, and for the purpose of inducing the above named State Corporation, Jones Lock Co. Inc., its officers, agents and employees, to furnish me with employment and instruction in the hereinafter named trades and crafts, ____
____

I, the aforementioned John Doe do hereby contract and agree with the aforementioned Corporation:

That I will refrain from engaging, directly or indirectly, in any capacity whatsoever, with or without compensation, in the Locksmith Business, the Bicycle Business, the Key Business, the Auto Locksmith Service Business, the Bicycle Repair Business, - for a period of five years after the date when my employment with the said Corporation shall terminate, and at least five years from above date of this contract, - in any place which shall be within seven miles from the business location of the said Corporation:

The Corporation agrees that the employee shall have the right to terminate his employment upon verbally so declaring, without any notice to the Corporation whatsoever, and receive regular pay for the time employed.

The Employee agrees that the employer, the corporation, shall have the same right of instant termination of the employ, by verbal declaration.

The Employee agrees that he will not insert nor cause to be inserted in the ___________________________ Telephone Directory, nor in the ____________________ Classified Telephone directory, any listing or advertisement or firm name which shall offer Service in the above named trades, nor sales in the same of any article used or sold in the said trades, during the three years succeeding the date of termination of his employ with the corporation.

I HAVE READ THE ABOVE TERMS AND UNDERSTAND THEM
witness my hand this ______ day of _______19__
________________________, EMPLOYEE

Witness: ________________________________

For the Corporation, ____________________

____Pres. & Treas.______________________

7-1 A restrictive covenant agreement. The Locksmith Publishing Co

#10. Use declaration of ownership forms

When a customer enters your business premises, or when you are called to the customer's home, automobile, or place of business, have the customer sign a Declaration of Ownership form on which he or she attests to the fact that he or she is the owner of the premises or vehicle and has the right to engage you to perform services on the subject property. The use of such a form will demonstrate your intent to provide service only to those persons who are the true, legal owners. Whenever you are in doubt, try to obtain verbal or written confirmation from building owners, superintendents, company supervisors, neighbors, or clearance from law enforcement officials before you perform a service. Figure 7-2 shows a sample Declaration of Ownership form.

DECLARATION OF OWNERSHIP

I, ____
(Name)
____
(Address)
do hereby certify that I am the owner of the
Automobile ______________________________________
Make License No.
House/Apt. ______________________________________
Number Address
Commercial Establishment __________________________
Address
Safe ____
Make and Location
Box, Chest or Cabinet _____________________________
Description

I authorize *(your name)* to open the premises or articles above to fit keys or to make repairs to same.

I hereby agree to absolve said locksmith from any and all claims or to hold him responsible for any cause whatsoever by reason of the performance of his work.

Owner ____________________________
Time _____________________________
Date _____________________________

7-2 A Declaration Of Ownership form. The Locksmith Publishing Co.

STATE LAW VARIATIONS

As mentioned earlier, every state and city has their own particular laws and ordinances that govern the operations and the permanent and temporary licensing and certification of locksmiths, apprentice locksmiths, and keymakers. The following excerpts from Nebraska and New York City laws are provided to demonstrate the differences in restrictions placed on locksmiths and in the definitions of industry terminology. This information is supplied for demonstration purposes. Contact your local and state officials for the current laws pertaining to the jurisdictions in which you live.

The Nebraska laws are as follows:

(g) LOCKS AND KEYS

28-1315. Locks and keys; terms, defined.

As used in section 28-1316, unless the context otherwise requires: (1) Change key shall mean a key planned and cut to operate a specific lock; (2) Try-out key shall mean a key which may or may not be one of a set of similar keys, each key made to operate a series or group of a total series of locks, the key or keys being constructed to take advantage of unplanned construction similarities in the series or group of locks;
(3) Wiggle key or manipulation key shall mean a material device which may be variably positioned or manipulated in a lock's keyway until such action develops a condition within the lock which enables the lock to be operated. Wiggle keys or manipulation keys may or may not resemble normally-used keys;
(4) Master key shall mean a key planned and cut to operate all locks in a series or group of locks, each lock having its own key other than the master key for that individual lock only, and each lock constructed as a part of the series or group for operation with the master key. For the purpose of section 28-1316, submaster keys, grand master keys, emergency keys, and over-riding keys are to be considered as master keys;
(5) Keyed-alike locks shall mean a series or group of locks designed and constructed to be operated with the same change key;
(6) Locksmith shall mean a person dealing in the mechanical action and the correct operation of all types of locks and cylinder devices, whose trade or occupation is primarily repairing, opening or closing such locks or devices by mechanical means other than the key designed for that particular mechanism without altering, marring, or destroying the original condition or effectiveness of such mechanism, and
(7) Key master or key cutter shall mean a person other than a locksmith, whose primary and only function is the cutting and duplicating of keys.
28-1316. Unlawful use of locks and keys; penalty; exceptions. (1) A person commits the offense of unlawful use of locks and keys if he:
(a) Sells, offers to sell, or gives to any person other than a law enforcement agency, dealer licensed under the provisions of Chapter 60, article 14, motor vehicle manufacturer, or person regularly carrying on the profession of a locksmith and try-out key, manipulation key, wiggle key, or any other device designed to be used in place of the normal change key of any motor vehicle; or
(b) Has in his possession any try-out key, wiggle key, manipulation key, or any other device designed to be used in place of the normal change key of any motor vehicle unless the person is a locksmith, locksmith manufacturer, dealer licensed under the provisions of chapter 60, article 14, motor vehicle manufacturer, or law enforcement agency; or
(c) Duplicates a master key for anyone unless written permission has been granted by the person who has legal control of the master key. All master keys shall be stamped with the words DO NOT DUPLICATE. All duplications of master keys shall be stamped with the words DO NOT DUPLICATE.
(2) nothing in subsection (1) of this section shall be construed to make it unlawful if:
(a) The owner of two or more vehicles possesses a change key that can be used on two or more vehicles that he owns; or

(b) Such owner changes the locks on such vehicle so that they are keyed alike; or

(c) Any person makes or duplicates the original change keys for such an owner; or

(d) Anyone stamps any other type of key with the words DO NOT DUPLICATE.

(3) Unlawful use of locks and keys is a Class III misdemeanor.

28-1402. Locksmiths; registration certificate; issued by county clerk. All locksmiths, as defined in section 28-1315, shall be required to hold a valid registration certificate issued by the county clerk in the county in which the locksmith's business is located.

28-1403. Locksmiths; registration certificates; application; contents; fee. The county clerk shall provide the registration certificates upon receipt of a fee of five dollars. Every locksmith shall conspicuously display such certificate in his place of business. The application shall be filed in the manner and form prescribed by the Secretary of State, and shall include as a minimum (1) the name of the applicant, (2) the name of the applicant's business, (3) the address of such place of business, (4) whether the applicant has been convicted of violating the laws of any state, other than minor traffic violations, and (5) who have the knowledge of the applicant's character, experience, and ability. It shall be the duty of each county clerk to supply each applicant with an application form and to file a copy of each application, which application shall be public information.

28-1404. Locksmiths; registration certificates; terms of validity. The registration certificate shall remain valid until such time as the name of the individual, the name of the place of business, or the address of the place of business changes. At the time of such change a new registration shall be required.

28-1405. Locksmiths; registration certificates; failure to acquire; penalty. Any person, firm, or corporation who fails to acquire a valid registration certificate pursuant to the provisions of sections 28-1402 to 28-1405 shall be guilty of a Class IV misdemeanor.

The New York City laws are as follows:

CITY OF NEW YORK
ADMINISTRATIVE CODE
Title 20
Department of Consumer Affairs
Chapter 2
Licenses
Subchapter 15
Locksmiths

Section 20-298. Definitions. Whenever used in this subchapter, the term "locksmith" shall mean a person dealing in the mechanical actions, and the correct operations of all locks, key or keyless, or similar devices, and whose trade or occupation is repairing, servicing, installing, inspecting, opening and closing such locks by mechanical means, other than with the regular key made for the purpose, without altering, marring or destroying the original condition or effectiveness of such locks or similar devices in any shape or manner, or a maker or manufacturer of locks, pressure keys, skeleton keys, pass keys, jigs, or any other mechanical device to aid a locksmith in the plying of his or her trade.

HISTORICAL NOTE: Amended by Local Law No. 64 of 1955, June 20. Amended by Local law No. 64 of 1992.

Section 20-299. License Required. It shall be unlawful for any person to carry on the business, trade or occupation of a locksmith, or for any person employed in a hotel, apartment house, office building, store, garage, service station, luggage shop, or any other establishment, to perform the duties of a locksmith, without a license therefor.

HISTORICAL NOTE: As amended by Local Law No. 64 of 1955, June 20. Amended by Local Law No. 64 of 1992

Section 20-300. License Fee. The fee for a locksmith's license shall be fifty dollars.

HISTORICAL NOTE: Section amended by Local Law No. 20 for 1947, December 1. Local Law No. 64 for 1955, June 20. Local Law No. 44 for 1970, August 10. Subdivision b repealed by Local Law No. 74 for 1977, October 6. Amended by Local Law No. 64 of 1992.

Section 20-301. Regulations. (a) It shall be unlawful for any person other than a licensed locksmith to open any lock for which a key or combination may have been lost; or to make any repairs to, or change in, the mechanical adjustment or combination of any lock; or to make any original key or any other device or contraption to open a lock.

(b) Every licensed locksmith shall keep a book in which he or she is to record: (1) the name and address of every person ordering master keys, keys by number, or ordering the opening of a locked item and the date and time such work was done; and (2) the means relied upon to identify any person ordering the opening of a locked item and to verify ownership of a locked item. Such book shall be open at all reasonable times for inspection by the commissioner, any department inspector, any police officer, or any person duly authorized by the commissioner.

(c) Every licensed locksmith, except an itinerant locksmith, who is requested to open a locked item which is located on the premises other than where the business is conducted shall, prior to opening such locked item, indicate the display of the license issued hereunder to any person requesting the opening of such locked item.

(d) Every locksmith shall make a good faith effort to: (1) determine the identification of any person requesting the opening of a locked item; and (2) obtain proof that a person requesting the opening of a locked item is the proper owner of the locked item or is authorized to request that the locked item be unlocked.

(e) Every locksmith opening a locked item shall obtain the signature or mark of the person requesting the opening of such locked item on a form to be prescribed by the commissioner. Such form shall state, in such manner as the commissioner shall by rule establish, that the person requesting that an item be opened is authorized to open that item. The forms shall be retained by the locksmith in such manner as the commissioner shall require, and shall be available at all reasonable times for inspection by the commissioner, any departmental inspector, any police officer, or any person duly authorized by the commissioner or any judge of the criminal court.

HISTORICAL NOTE: As amended by Local Law No. 64 for 1955, June 20. Section 20-301 amended by Local Law No. 11 of 1992.

Section 20-302. Equipment to be listed. Each manufacturer or jobber of devices aiding locksmiths in their trade shall file a list of his equipment with the department and with the police department, enumerating in such list all master-key blanks, code books, machinery, skeleton keys that open and operate more than one lock and known to the trade as pressure keys, key sets for automobiles, vibrating lockpickers, and all similar equipment in his or her possession. It shall be unlawful to dispose of any such equipment to any person other than a licensed locksmith.

HISTORICAL NOTE: As amended by Local Law No. 64 of 1955, June 20.

Section 20-303. Keys to be marked. All keys made by a licensed locksmith shall be stamped with his or her name and address or with the license number issued to him or her by the commissioner. All master keys in addition shall bear the word "master" and duplicates shall be made only upon the signed order of the owner of the locks which such keys are designed to operate or his or her authorized agent. Master keys shall be made only by a licensed locksmith.

HISTORICAL NOTE: As amended by Local Law No. 73 of 1960, November 7. Amended by Local Law No. 64 of 1992.

Section 20-304. Licenses to be displayed. Every licensed locksmith shall display the license issued hereunder in a conspicuous place where it can be readily seen by anyone entering the premises where the business is conducted. Where the licensed locksmith is not in business for himself or herself, but is employed by another, it shall be incumbent upon the licensee and his or her employer to display the license hereunder in a conspicuous place where it can readily be seen by anyone entering the premises wherein the business is conducted. Where more than one locksmith is employed in such premises, the license of the person then in charge need only be displayed. In the case of an itinerant locksmith the license shall be on his or her person or prominently displayed upon the working kit he or she may carry or upon any vehicle which he or she may use in the plying of his or her trade or occupation.

HISTORICAL NOTE: Amended by Local Law No. 64 of 1955, June 20. Local Law No. 1 of 1967, January 6. Amended by Local Law No. 64 of 1992.

Section 20-305. Prohibition as to itinerant locksmiths. It shall be unlawful for any licensed itinerant locksmith to ply his or her trade or occupation or maintain a stand within five hundred feet of any store or other permanent place of business of a licensed locksmith, or at any other place upon the streets or highways of the city where police regulations will not permit.

HISTORICAL NOTE: As amended by Local Law No. 64 of 1955, June 20. Amended by Local Law No. 54 of 1992.

Section 20-306. Proof of qualifications; fingerprinting. (a) The commissioner shall require any applicant for a locksmith's license to furnish documentary proof that he or she is a qualified locksmith, and if such evidence is not satisfactory to the commissioner, the commissioner may require the applicant to submit to an examination by at least two licensed locksmiths to be named by the commissioner, to serve without compensation, and such licensed locksmiths, after examining the applicant shall certify in writing to the commissioner whether or not the applicant in their opinion is sufficiently qualified to be licensed as a locksmith.

(b) The commissioner shall require that applicants for licenses issued pursuant to this subchapter be fingerprinted for the purpose of securing criminal history records from the state division of criminal justice services. The applicant shall pay a processing fee as required by the state division of criminal justice services. Fingerprints shall be taken of the individual owner if the applicant is a sole proprietorship; the general partners if the applicant is a partnership; and the officers, principals, directors, and stockholders owning more than ten percent of the outstanding stock of the corporation if the applicant is a corporation. Any person required to be fingerprinted hereunder shall furnish to the department three current passport-size photographs of such person. Notwithstanding the foregoing, the commissioner need not require applicants for licenses required under this subchapter to be fingerprinted if criminal history records concerning such applicants are not available from the state division of criminal justice services.

Section 20-306.1 Refusal to issue or renew, or suspension or revocation based on criminal conviction. In addition to any of the powers that may be exercised by the commissioner pursuant to this subchapter or chapter one of this title, the commissioner, after notice and an opportunity to be heard, may refuse to issue or renew, or may suspend or revoke a license required under this subchapter if the applicant or licensee, or any of its principals, officers or directors, or any of its stockholders owning more than ten percent of the outstanding stock of the corporation has been convicted of a crime which, in the judgement of the commissioner, has a direct relationship to such person's fitness or ability to perform any of the activities for which a license is required under this subchapter or has been convicted of any other crime which, in accordance with article twenty-three of the correction law, would provide a justification for the commissioner to refuse to issue or renew, or to suspend or revoke, such license.

HISTORICAL NOTE: As amended by Local Law No. 64 for 1955, June 20. Section 20-306 and amended by adding Section 20-306(b) and Section 20-306.1 by Local Law No. 66 for 1989.

Section 20-307. Exceptions. (a) Members of city, state or federal departments, who are assigned to locksmith work, wholly within their respective departments or divisions shall be exempt from the operation of this subchapter.

(b) No person shall be employed by a duly licensed locksmith as an apprentice or trainee unless such person shall have a trainee-license, the annual fee for which shall be ten dollars, and during the time in which

> such person is so employed he or she shall be under the direct supervision of said licensed locksmith and such person may perform the duties of a locksmith. Such apprentice or training period shall not exceed thirty-six months. Each such licensed locksmith employer shall be responsible for notifying the department as to the termination or change in the employment of any such apprentice or trainee.

WHAT YOU CAN AND CANNOT DO ACCORDING TO THE LAW

Inevitably, when you begin working as a locksmith or if you are already a professional locksmith, many situations might arise that simply are not covered under the laws and regulations of your state or city that govern the operations of locksmiths. Because your are not a lawyer or judge, some of these instances might cause you to hesitate or to later question your own actions. For this reason, we have included several questions and answers that have been published by the locksmith industry. Although these are not to be used as concrete, legal advice, they will give you a fair appraisal of how the law, in most states and in general, views certain actions and the legal responsibilities of locksmiths.

Question #1

Last week I was called to an apartment to change the combination of the door cylinder. The man met me at the door and let me in. I changed the combo, collected my fee, and went about my business. Later I got a phone call from the lady of the house telling me that I had no right to change the lock. She explained that she and her husband were separated and that he had the lock changed in order to keep her out. He didn't live there, but picked a time when she went shopping to make it look as though everything was on the up and up. Now, what I want to know is, where do I stand in a situation like this?

Answer: Combination changing seems to be one of the pastimes that separated and divorced couples enjoy. However, you're in the clear! You performed the job for one of the rightful owners of the household. Since the couple was not yet legally divorced, they owned the house in common. The man had the right to order you to do the job, even though it was a mean trick to play on his wife.

As a sequel to this, I'd like to inform you that the Superior Court of Rhode Island recently ruled in a similar case. The judge ruled that the wife still had the right to the use of the home since the couple were not divorced, and that the husband had no right to lock her out. The locksmith who performed the job was in no way involved whatsoever. However, marital woes are troublesome. If it's that kind of job next time, you'd do better to avoid it. It can get complicated!

Question #2

An apartment house tenant asked me to install a jimmy-proof deadlock. Should I get the landlord's permission first?

Answer: This is quite different from the previous question. This involves drilling a hole through the landlord's door and cutting into the landlord's door frame. I recommend getting the landlord's permission. He will usually give it if the tenant agrees to leave the lock when he vacates. It should be noted that an agreement between the tenant and you, whereby the tenant agrees to hold you harmless, won't do you a bit of good if the landlord chooses to sue you for $100 to $200 for installing and refinishing a new door and frame. Here again you are supposed to know the rules governing your business. If you chop up Mr. Landlord's building you are civilly, and in some cases criminally, responsible. I don't believe it's necessary to get permission from the landlord in writing.

Question #3

An apartment dweller wants me to change the combination of his lock. May I do it without getting the landlord's permission?

Answer: You may. It is the tenant's obligation to return his apartment (including the lock) to the landlord at the expiration of his tenancy in the same condition he received it, reasonable wear and tear accepted. This the tenant can do by having it changed back when he moves out. Even if the terms of the tenant's lease prohibit such a change, that's a matter of contract between the landlord and tenant and isn't binding upon you. If you replace the whole cylinder, I urge that you give the tenant the old one. Don't take it in exchange or carry it away. It isn't the property of the tenant and therefore he can't give you title to it and you are supposed to know that.

In relation to question 3, if might be advisable to contact the landlord first, and find out if the building's locks are under an existing master-key system. Many landlords of large apartment complexes will not allow a tenant to have a lock rekeyed for the sole purpose of keeping the landlord out. If you ignore this situation, you could find yourself liable for any damages that might occur from keeping the landlord from entering the tenant's apartment to carry out emergency repairs. Most landlords, however, will let you rekey a tenant's lock as long as you agree to pin it up in a manner that will still let the landlord's master key operate the lock.

Question #4

Am I civilly or criminally responsible if I open a car and supply a key for a thief?

Answer: In most states, no criminal liability would attach to you. That is you couldn't be fined or jailed unless the state is able to prove that you were grossly negligent in the conduct of your business, or that you deliberately conspired with the thief. Keep in mind, however, that the attitude of judges on the point generally attaches a deal of responsibility to the locksmith. It is felt that "if he is running a locksmith business he should know what he may do and what he may not do for the protection of the public." A locksmith who is about to pick open the lock in an apartment for a "customer" and who has asked a neighbor or the janitor to identify the customer first is, for all practical purposes, exercising due care. Or if a locksmith requires the auto customer to show a license and registration for the car plus personal identification, the locksmith can never be charged with negligence.

On the civil side of the ledger (that is a noncriminal suit for damages by the injured party or true owner) a locksmith should exercise an even higher degree of care. He or she must go to special pains to be sure that a divorced spouse was let into an apartment or automobile because of his or her services. In many cases, the locksmith is sued as a "joint tort feasor" upon the premise: through his or her negligent conduct, the plaintiff suffered property loss. But note that the word "negligent" comes in again. You won't have to pay for a $3,000 car or for $5,000 worth of antiques, jewelry, or furniture that were lugged off by the thief or spouse, if you exercise a little care when you do opening jobs. Jot down on your job record the name of the neighbor who identified the customer and watch out for the faintest "smell" on the job.

Question #5

If I am called to make a key for a pin ball machine or a penny scale, what should I do?

Answer: Generally speaking, turn the job down. If you feel you must do it, examine the machine carefully for any sign that it is owned by a concessionaire and then contact the concessionaire to find out whether he or she still owns the machine and whether the store keeper has the right to make a key for it. If there is no tag or label indicating the machine is there on a concession basis, ask the store keeper to show you a bill of sale for it. If he or she has none, check with the company who sold him or her the machine. Then you will be exercising due care.

Where a concessionaire owns a group of machines that he or she puts in various stores on a percentage basis and the machines are so plainly marked, a locksmith who supplies the storekeeper with a key to the machine is liable to the concessionaire for the amount of money taken out by the store keeper. If it can be shown that the locksmith knew or should have known by all the apparent facts that the store keeper had no right to a key, he or she could be held liable for criminal conspiracy and larceny.

OTHER CONSIDERATIONS

In addition to state and city laws, there are other laws and regulations that a locksmith might be required to observe. For instance, many municipalities require that any type of service-oriented business file for and obtain a home-improvement contractors license. Although locksmiths who perform only general lock work might not need to do so, they might be required to file for one if they intend to perform any electronic alarm work or structure-attached grill work, such as window security gates. In addition, some shop owners might be required to file for an automotive state inspection license if they intend to do any type of automotive lock or automotive alarm work. Also, some states require everyone, including locksmiths, to have a state-issued alarm license in order to install electronic burglar or fire alarm systems. Check with your local authorities and local association for complete details covering your area.

The Americans with Disabilities Act

One of the most important laws to affect locksmiths and other security professionals is the Americans with Disabilities Act (ADA), which went into effect July 26, 1990. The ADA was passed to ensure that all people with physical and mental disabilities have proper and safe access to employment, public accommodations, commercial facilities, government services, transportation, and telecommunications. Make sure that any time you install any security or access devices that they conform to the rules and regulations of the ADA. Noncompliance with the ADA can result in penalties of up to $50,000 for the first offense, and up to $100,000 for additional offenses. It is strongly suggested that you obtain all the information that you can about the ADA and those sections with which you as a locksmith might come in contact, such as access devices, lock hardware, exit devices, etc.

8

How to set up a small, one-person shop

Starting a locksmith business is no different than starting any other business. However, having as much technical and working experience as possible before starting your own locksmith shop certainly is preferable. Starting a business isn't for everyone. For every 10 new small businesses, only one survives after the first year.

This chapter deals only with the specifics that are unique to the locksmithing craft. Defining the business structure for legal purposes, such as proprietorship, partnership, or corporation is best left to a business lawyer. Tax structures, legalities, and responsibilities of small businesses should also be left to an accountant. Before you decide to start your own business, visit a lawyer and accountant to find out what your responsibilities are under the law and how much starting up a small business is going to cost.

START WITH EXPERIENCE

Many locksmith businesses fail because their owners have tried to learn on the job. No matter how much schooling and technical training you might have had, there is no better substitute than experience. Working for other shops can show you that locksmithing can involve much more than just the technical aspects. Knowing how to deal with customers and legal issues, keeping records, advertising, and pricing is just as important as knowing how to rekey a lock. On the other hand, technical experience and know-how is just as important. When a customer calls on the phone for a specific product, you'll have to know how that product is specified, supplied, installed, and serviced. A two- to three-year work history is recommended. Many cities require that beginning locksmiths work for a three-year period as an apprentice. By then, you should know enough about locksmithing in general, as well as in your own special skill area.

WHERE TO OPERATE FROM

Once you have the paperwork out of the way (business established), you'll have to decide where to work from. Of course, how much you have to spend is a major factor. Whether or not you choose to operate from your home, a storefront, or mobile shop, how much you have or how much you can borrow plays a key role in where you operate from.

Operating from home

Many small lockshop owners run their businesses from their home. This has its advantages and disadvantages. On the negative side, operating from home limits you to basically service calls. In this type of arrangement, advertising plays a key role. You'll probably need more advertising than a storefront would for the simple reason that your shop is not visible or accessible to the public.

Most home shop owners rely heavily on yellow book ads, flyers, and word of mouth to attract new customers. Another disadvantage is the walk-in business loss. Your phone is the only connection between you and new customers, so be sure to have a separate phone installed with at least three extensions so incoming calls can be answered immediately.

Another disadvantage to running a home shop is missing calls while you are out on a service call. This is where a beeper plays an important part. If you are not lucky enough to have someone sitting at home answering the phone, then at least each call coming in can be recorded (with an answering machine) or will go directly to you.

Operating costs for a home shop can be much lower than that of a storefront—and that is an advantage. You won't have to pay rent, store electricity, and even some insurance costs can be eliminated. The costs of product displays are also eliminated, as are the important aspect of hiring additional personnel. A home shop owner usually does everything by himself: performing service calls, answering phones, keeping records, banking, ordering materials, etc.

For a home workshop, you'll need to have a spare room. Although a garage can suffice, this isn't recommended because of the possibility of theft and varying weather conditions. To use the shop as efficiently as possible, there should be adequate room to store tools, materials, spare parts, technical literature, catalogs, key machines, pinning kits, etc. You'll also need a table large enough to use as a work table, and a wall wide and high enough to hang a keyboard.

Mobile locksmithing

The mobile locksmith is perhaps the most restricted. Some locksmiths don't own their own home or do not have the luxury of having a spare room available. Although some locksmiths may start out working from a car, this method is not recommended. A car will not supply you with enough room for supplies and tools. Your best bet is to start out with a van. A mobile locksmith does most if not all of his work inside his van or step-up truck. Many rekey jobs and other miscellaneous work will have to be done in the van.

Storefront

If capital allows, setting up a storefront is the best bet for exposing your new business to the public and bringing in the most business. Where you put your storefront, however, is of extreme importance. You'll want an area that has a large amount of foot traffic. Good locations include near bus and train stations, shopping malls, schools, hospitals, office complexes, other businesses, and almost anywhere else where there is a large amount of consumer and commercial traffic.

Of course, not everyone can afford a storefront from the outset. This is when a good credit history is important, because you'll want to obtain financing from a bank. Many banks and other lending institutions do not provide business loans to small, beginning businesses until they can show year-end gross receipts for the first two years and possible growth potential thereafter.

Setting up a storefront will probably require you to hire at least one other locksmith or locksmith apprentice. It is nearly impossible for one locksmith to run a storefront and take care of service calls and the rest of the business. You don't want to close your doors every time you have to go out on a service call.

The one disadvantage to a storefront is cost. You'll be paying rent, gas and electric, insurance, and whatever additional costs the municipality you rent in requires. This means you'll have to do more business to offset the costs.

ADVERTISING

The best time to plan the start-up of your business is when your local and largest advertising contract hits the market. This might be in the form of a yellow page ad, a business-to-business ad, or in local papers. Your business should be operating from the very first day the ads come out.

First, however, you'll need to do some research. Most locksmith businesses use yellow page ads as their prime source for bringing in new business. They also use flyers and business cards. Talk to other shop owners and other locksmiths to find out which type of advertising works best. Remember that the locksmith business is a service-oriented trade, which means that many calls you receive will be for emergency services, i.e., automobile lockouts, residential lockouts, break-ins, lost keys, etc. Many of these calls will bring new business in the form of lock installations, new anti-theft prevention devices for automobiles, and similar devices.

Types of advertising

There are other ways you can bring in potential business and at the same time get your name out in front of the public. Many communities have local advertising space available on cable TV. These 15-30 second spots are not very expensive and can build your business up considerably with just a few reruns. Radio advertising is another form. Although it might not be as productive as TV and print advertising, if you can afford it, you'll be amazed at the business it will bring in.

Putting your company name and phone number on your service van is another good form of advertising—you can literally reach thousands and thousands of potential customers this way. Sponsoring school PTA security shows is another good way to attract customers. Whether or not you have children in school, you can still use this effective method of advertising to reach many members of the immediate community. Advertising in church bulletins, supermarket flyers, college newspapers, real estate listings, and sending discount coupons through the mail are additional ways to reach customers.

Direct mail is important, but you can use direct mail in more than one form to keep your name out in front. Two well-known methods are through company newsletters and sales brochures.

Company newsletters

Company newsletters can be desktop published by yourself or you can hire a company or printer who specializes in this form of advertising. A company newsletter usually contains three to four pages of new or interesting news concerning the industry that you are in. For example, a locksmith newsletter might focus on new security products, statistics on local crime, security seminars (that your company is conducting), fraud alerts, or even small articles about security from noted professionals in the field. Company newsletters are usually sent out bimonthly or quarterly to current customers, past customers, and even entire mail listings in one zip code area. The main idea of a company newsletter is to remind your current and potential customers that you are a full-service oriented company that keeps up-to-date within your industry.

Sales brochures

Sales brochures are similar to company newsletters except in the aspect of advertising the complete line of services and products you supply. What you put in the sales brochure should correlate to the services and only the services and products your company offers. For example, if your company specializes in automotive locksmithing, that topic should take up the main space of advertising, and the first one the reader sees. A short history of your company background, or of your own professional achievements in the industry, should also be included. The sales brochure should also list all the services you provide, from cutting keys to installing residential and commercial alarm systems. It should also highlight the fact that your company provides 24-hour emergency services, and of course should have your company's address, phone number or beeper number listed.

A typical advertising brochure should be made on an 8½ × 11-inch sheet of paper that can be folded in half, thirds, or quarters to form separate panels. This size brochure can easily be put into a normal size business envelope.

INVENTORY

A properly run inventory system supplies just enough materials and supplies to satisfactorily service customers. What this number might be, in amounts of goods and supplies, might have to be determined by a trial run period when the business first starts up. If you've worked for other shops beforehand, however, then you should have a general idea of how many products should be stocked. Generally, a business should invest the least amount of money in inventory necessary to maintain its sales volume and provide a high level of service to its customers.

For instance, a locksmith storefront probably does a great deal of business cutting keys, therefore, it would be productive to stock a large amount of key blanks, key rings, and other key-related items rather than have a shortage. All experienced locksmiths know that many profitable service calls come directly from customers who have had keys cut at their shops.

Other factors

You have to consider how long it takes for ordered material to reach you. If you are lucky enough to be within close driving distance to your local distributor, then you probably won't have to stock many products; you can head to the distributor on your way to a job. Not every shop is that lucky, however. Sometimes mailing periods take a day or two and can build in shipping costs as well. This is when stocking a dozen or two of one product can be more productive and cost-efficient. Nothing is more depressing and harmful to a locksmith business than not being able to supply a common security product (like a deadlock) on a moment's notice.

Purchasing discounts

Many distributors and manufacturers offer discounts if you purchase in high quantities. A small locksmith shop might pay $12 for a particular brand of lock (because the owner only buys half a dozen at a time), but a chain home center might pay only $4 for the same lock because they buy in much higher quantities. You'll have to outweigh the higher cost, however, with how long you think it will take to sell most of the stock (most locksmith shops stock enough for no more than a four- to six-month period). Also weigh off the extra cost for purchasing in higher quantities against the amount you save versus what you would have made in interest had you kept the additional amount of cost in the bank. If you spent $400 extra but saved $40 in discounts, would you have made at least $40 more in interest had you kept that $400 in the bank during the last interest period?

Inventory control

The more employees you have and the more inventory you have the harder it becomes to control loss of inventory due to employee theft or employees losing or ruining material and products. A large amount of inventory also can be counterproductive because of new products on the market, which happens frequently in the security hardware business. Many manufacturers discontinue sales or production of spare parts once their newer products are released. You won't want to be left with a few hundred dollars worth of locks that are now considered obsolete.

Merchandise that sits on a shelf for six months or more is not making you any money. It is tying up valuable capital that could be used elsewhere.

MERCHANDISING THE SHOP

Merchandising the merchandise is an art form and a skill in itself. When a customer walks into your store, he or she might have to stand around for a few moments while you cut their keys. This is where a counter display, standing rack (gondola), and wall-hung merchandise begin to sell themselves.

Many small locksmith shops stock only a small supply of inventory, and keep that inventory out-of-sight. This method might be good for security reasons (theft-control) but it does nothing for promoting retail sales. Whenever possible, you should purchase residential security products in see-through packaging so it can be hung out on the display racks for customers to see.

Self-standing gondolas are one of the best forms of merchandising. These racks can be placed in the middle of the store, or centered accordingly to allow enough walking room between each one. Hang the products categorically, which means keep the deadlocks with the deadlocks, the key-in-knob locks together and other miscellaneous products in the same area. Key accessories, like decorative key rings, key fobs, and key chains should be placed near the key machines or the cash register where customers can see them as they wait. Other products in specialty areas, like automotive anti-theft devices (steering wheel locks, wheel locks, trunk lock protectors, etc.), should be placed separately on their own display racks.

One mistake many locksmith shops make (and don't you) is to place large retail specialty items, like home safes, on the floor of the store. Any good merchandiser knows that this is a foolish practice, as well as a dangerous one. Anyone interested in purchasing a safe doesn't want to have to get down on their knees to open and examine the inside of a safe cabinet. Items like safes should be placed on built-up (and sturdily built) display stands, which enable customers to make direct eye contact with and touch these highly-profitable sales items.

HOW TO SET AN HOURLY RATE

The *hourly rate* can be described as the per-hour labor charge that a business determines it should charge to sell its labor. The hourly rate a locksmith business should charge is the amount the business needs to reach the break-even point after all operational expenses have been met and once it determines what profit it should make per hour. This amount, however, can be different for one shop to another. A general formula for figuring hourly rate in the locksmith industry is:

Fixed expenses ÷ hours worked = breakeven hourly rate.

The following example is for a typical New York City one-person locksmith business:

Fixed Expenses (per-month)	
Rent	$1,200
Heat	200
Electric	225
Salaries (for one-man operation)	1,600
General operating insurance	100
Gas	200
Truck repairs	100
Vehicle insurance	140
Advertising	370
Miscellaneous expenses (office supplies, shipping, etc.)	100
Tool costs	50
Locksmith supplies	100
Educational expenses	50
Total cost per month	= $4,435

Once the fixed expense amount is reached, it should be divided by the number of hours that a shop expects to work in an average month. For example, 8 hours per day × 5 days per week = 40 × 4 = 160 hours.

$$\$4{,}435 \div 160 = \$27.72$$

The amount this particular shop must make per hour to break-even after meeting fixed expenses is $27.72. After this amount is reached, the amount of profit the shop feels it should make for each hour worked must be calculated. (This figure should be close to the figure you could earn by simply putting your money into a savings account.)

To reach this figure, first determine how many productive hours your shop must have each working day. For instance, not every hour of every working day is productive. You simply have to take into consideration slow days, but when fixed costs still remain. For this process, a multiplier system is used. One of the common multipliers used in the locksmith industry is shown in Table 8-1. For example, say your shop is nonproductive for two hours per day. You then multiply the given multiplier for that figure, which in our example case is 1.25, by the present fixed hourly rate, which was $27.72.

$$\$27.72 \times 1.25 = \$34.65 \text{ (projected hourly rate)}$$

Table 8-1
Hourly rate multiplier

Nonproductive hours per day	Multiplier
1	1.125
2	1.25
3	1.375
4	1.5
5	1.625
6	1.75

Keep in mind that all nonsold labor employees (secretary, stock person, counter person) should be included in fixed expenses. In the case of multi-employee shops (where there might be four servicepeople) then the fixed expenses must be divided among all service personnel to determine what each must produce to reach the total break-even point. Expected profit is then added to each serviceperson's share of fixed expenses to finally arrive at the correct hourly rate.

The question might arise: should a one-person shop operating from a home that does not accrue half of these expenses charge as much as a storefront owner? This question is not only a financial one but also an ethical one. Many larger, established shops complain that one-person shops are running them out of business because of their lower operating expense. They can afford to charge service prices that larger shops cannot compete with. A large shop might have to charge $45 an hour or higher for labor, a small one-person shop might only have to charge $25 per hour. On the other hand, the larger shop may actually need to charge up to $60 an hour to break even. Charging such a large amount would not get them very much business, however, so they then have to increase their sales volume to offset the loss in sold-labor revenue and/or offer less employee incentives and benefits to their workers.

The small, one-person shop also has a similar problem, but in the reverse. If the small, one-person shop owner now charges only $25 per hour, how can he raise his service fee to $45 an hour once his business grows and he opens a storefront? Most assuredly, he will lose a great deal of business because of that tremendous raise. A solution is to average out the labor costs systematically according to types of services rendered while considering future expenses for business growth. For example, a one-person shop specializing in safe servicing and automobile lock work might charge the following for each specific type of service:

Safe labor rate	$60
Auto door lockouts	50
Basic hourly rate	34.65

With this system, he might be able to pacify the larger shop by showing that his prices for other work coincides with theirs (if he is worried about ethics within the industry). If he makes the mistake of charging the same amount that they do, and pulls in a very nice profit, he will have the financial catastrophe of later losing a tremendous amount of profit when he opens up a storefront (and is not able to raise his prices even more to maintain the same amount of profits). The question of fair and profitable pricing is not an easy one to answer; however, an accountant's consultation might be advisable for planning future business goals.

INSURANCE

Once you start your own business, you'll have to consider what types of insurance you'll need for yourself, your family, and the business. The following types of insurances are the ones you'll probably want to consider:

- Group health insurance
- Group life insurance
- Key man insurance
- Buy-sell insurance
- Disability insurance
- Automobile insurance
- Product liability insurance
- Business interruption insurance
- General business package that includes general liability, theft, fire, unknown vehicles and computer records
- Workmen's compensation insurance
- Fidelity bonds for employee theft
- Special coverage, such as glass, flood, performance bonds, mortgage loan life insurance, off-premises coverage for goods, and accounts receivable insurance

Although some insurance coverage might be out of reach for the beginning entrepreneur, you should at least have the compensation insurance and the other types of insurance that can protect you and your new business against lawsuits. You'll also want to be protected against lawsuits arising from damage due to improper or faulty installations. If you will be installing alarms, you may need a separate insurance package because alarm liability is extremely high. There are insurance carriers that specialize in alarm company insurance.

Bonding coverage is important also. Bonding can be obtained within the industry from professional locksmith associations or from trade magazines to which you subscribe. Many of these associations cover you for up to $10,000 in claim loss due to subscriber's technical skill, employee skill, or for any revealing of a customer's safe lock combination to a person or persons who use that information maliciously. Keep in mind, however, that such payments are usually only granted once you have legally been convicted in a court of law. Being insured and bonded are two of the most important steps you can take for yourself and your company; it will prove to your customers that you are professional and trustworthy.

KEEPING RECORDS

Keeping records involves more than keeping a general ledger for Uncle Sam. Because locksmithing is a service-oriented business, records must be kept detailing each job, work order, supply order, emergency service procedure, etc. Locksmiths are also required by law (in some states) to keep records of all emergency services performed, keys cut by code, master keys originated and copied, safe combinations set and changed, etc. and must present these records to law enforcement officials or the courts when requested. Keeping company records can be simple or extensive depending on the size of your company and how many services it supplies.

LOCKSMITH SOFTWARE

As in most businesses today, computer software has become the main tool for recordkeeping. Specialized software geared toward locksmith businesses is available at reasonable cost. Software programs let you do everything from keeping a general ledger, mailing lists, writing checks, to printing out work order forms, invoices, and generating master key systems. Other programs can save valuable work space by including on computer disk complete code series for general locks and automotive locks. Other programs are available that cover technical skills and training.

Before you consider using computer software, you'll have to decide if the investment in computer equipment is practical. First, you must know something about computers. A typical, modern PC system with an 80-megabyte hard drive, monitor, and printer cost about $1,200 and up. The price will depend on how fancy and technologically advanced of a system you want. If you already own a computer, then you're ahead of the game. If you don't but would like to get one for personal and business reasons, then take a few basic computer courses before you go out and purchase any type of equipment or software.

Types of software programs

The following are the general types of software programs available for locksmiths:

- Master Key Software
- Keyblank Cross Reference Software
- Inventory & Invoicing Software
- Key Code Software
- Automotive Key Code Software

Part two

Basic locksmithing and advanced locksmithing techniques

9

Types of locks

There are different ways to refer to locks, but most locksmiths still use the standard definitions. The four basic types of locks are:

- pin tumbler locks
- lever tumbler locks
- disk tumbler locks
- warded locks

The word in front of the word *tumbler* describes the type of tumbler design used to allow or prevent the rotation of the cylinder plug. This information tells the locksmith what tools and supplies will be needed to service the lock, the procedures to use, and how to pinpoint the cause of the malfunction.

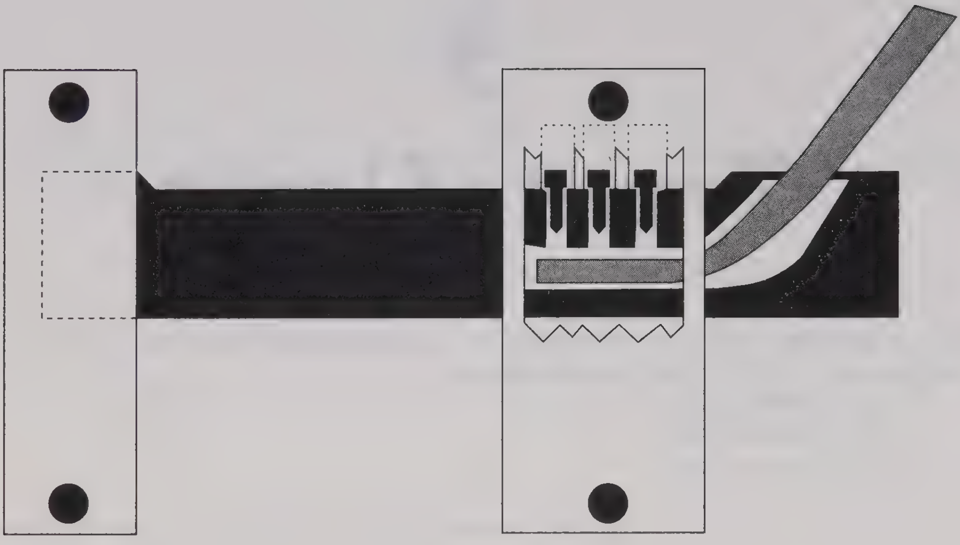
PIN TUMBLER LOCKS

The pin tumbler lock is the oldest type of lock known to man and still a popular lock today. The Egyptians invented the first pin tumbler lock more than 4,000 years ago. Today's locks employ almost the exact same design principle.

The Egyptian pin tumbler lock

The Egyptian lock consisted of a large piece of wood (or staple) that fastened directly to the door (see Fig. 9-1). Inside this piece of wood, which today would be considered the main lock body, was a bored-out hole large enough for the lock bolt to pass through. Inside it were three or more iron pegs with specially shaped nail-like heads that prevented them from entirely slipping through the lock body and bolt. When the bolt was inserted all the way into the wooden strike, which was attached to the door jamb, the pegs would fall down into pre-bored holes in the lock bolt, which aligned perfectly with the pegs and kept the bolt from being removed by hand, and, in turn, locked the door. To open the door, a piece of wood (key) with iron or wooden pegs attached to it was inserted into a hole bored into the end or top of the bolt. When inserted all the way, the wooden key would lift up and allow the pegs on the key to enter the same holes that the lock pegs entered, but this time through the bottom of the holes. The pegs would be lifted up just enough to raise the main lock body pins and give clearance for the bolt so it could be removed. This unlocked the lock.

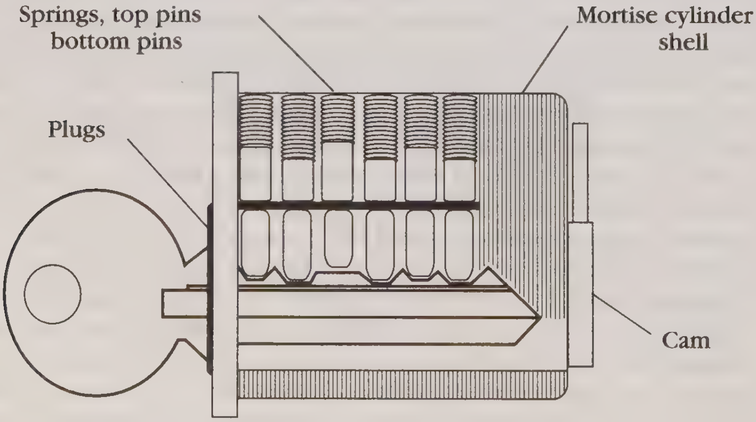
More notable still was that the first patent ever given for a pin tumbler lock cylinder was awarded to Linus Yale, Junior, founder of the Yale Lock Company, some time in the mid to late 1800s. Yale's pin tumbler cylinder embodies the most common and closest characteristics of the modern pin tumbler cylinder.



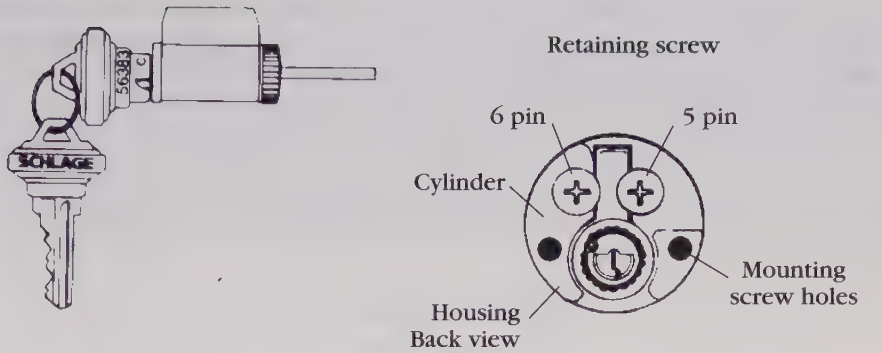
9-1 An ancient Egyptian pin tumbler lock.

Modern pin tumbler locks

A pin tumbler lock has cylindrical-shaped tumblers inside its cylinder, which allow or prevent the rotation of the cylinder's plug. The basic parts of a pin tumbler cylinder are the plug, shell, tumblers, springs, plug retainer, and cam/tailpiece. Figure 9-2 shows the basic parts of a pin tumbler mortise cylinder. Pin tumblers, the most common locks used today, can be used in almost any kind of lock: key-in-knob, mortise, rim, automotive, padlocks, desk locks, file cabinet locks, etc. Figure 9-3 shows a key-in-knob type cylinder. Most pin tumbler cylinders incorporate anywhere from four to six pin tumbler chambers.



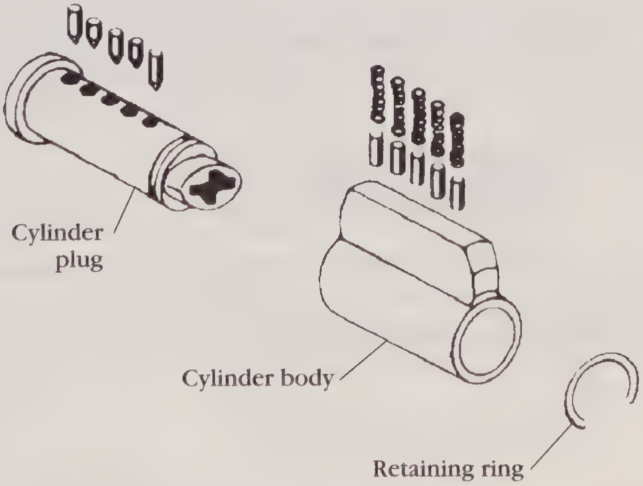
9-2 The parts of a pin tumbler mortise cylinder.



9-3 A standard key-in-knob pin tumbler cylinder. Schlage Lock Co.

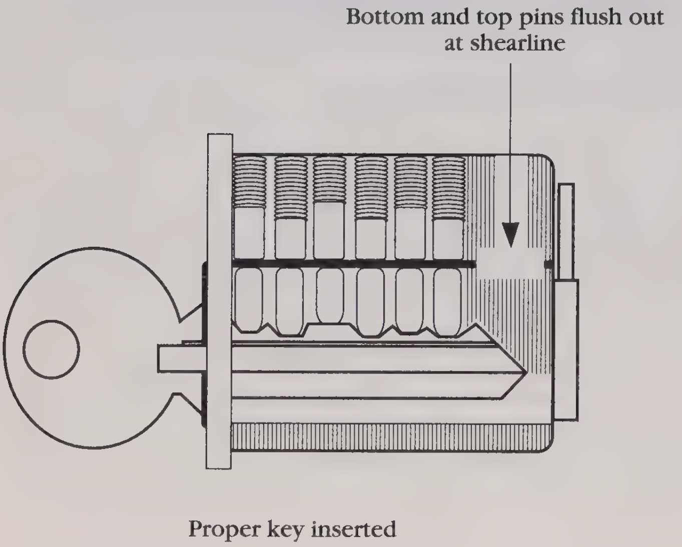
Basic operation

In a pin tumbler cylinder the bottom pins rest inside the cylinder's plug. The plug is broached out on the inside to cause the bottom pins to rest on a "pin stop land," which lies about halfway down into the plug and allows the proper key to be inserted into it. The top pins, or *drivers*, are forced atop the bottom pins through direct force that is applied to them by the springs. All three components (bottom pins, top pins, and springs) are kept under slight tension and are prevented from falling out of the entire cylinder assembly by a small, thin brass slide cap that slides into or is staked into the top of the cylinder shell. The plug itself is retained in the cylinder shell either by a C-clip or a cam that is attached to the back of the plug with two small screws (Fig. 9-4).

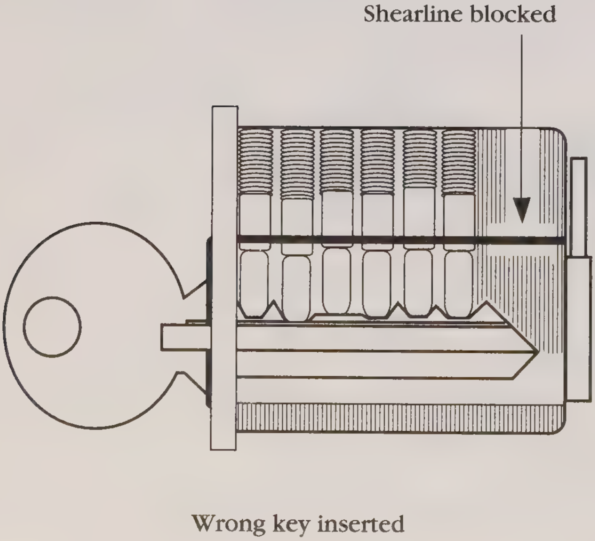


9-4 The internal parts of a key-in-knob pin tumbler cylinder. Schlage Lock Co

The small space, or *division*, between the top of the plug and the shell is known as the *shearline*. When no key is inserted into the cylinder's plug, the top pins block the rotation of the plug by resting across the shearline. When the properly cut key is inserted, the bottom pins and top pins "flush out" at the shearline and allow the plug to be rotated. After the plug is rotated, the cam at the back of the plug activates any one of a number of locking mechanisms to open the lock (Fig. 9-5). When an improperly cut key is inserted into the cylinder plug, either the bottom pins or the top pins will block the shearline and keep the plug from being rotated (Fig. 9-6).



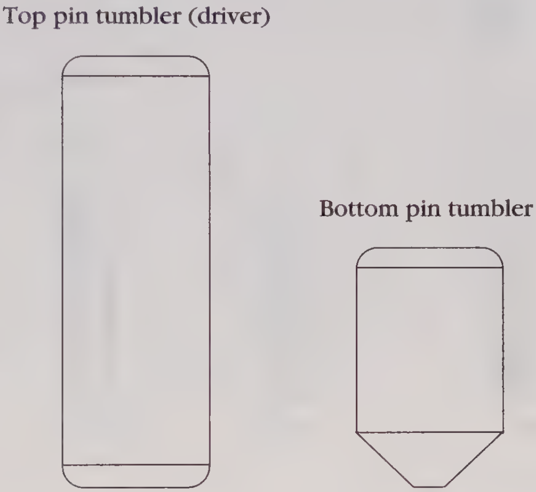
9-5
The properly cut key creating a shearline.



9-6
An incorrectly cut key and its result.

Construction

Most pin tumblers are made of brass, are cylindrically shaped, are .115 inch in diameter, and are cone- or bullet-shaped at the bottom to allow them to easily ride up and down against the cuts of inserted keys. Many pin tumbler manufacturers make them in 0.005-inch or 0.003-inch increments between sizes, and they usually range in length from 0.150 inch to 0.360 inch for bottom pins, and from 0.010 inch to 0.300 inch for top pins. The only difference between bottom pins and top pins is their construction. Top pins have flat tops and bottoms because they do not come in contact with the key (Fig. 9-7).



9-7 Standard bottom and top pin tumblers.

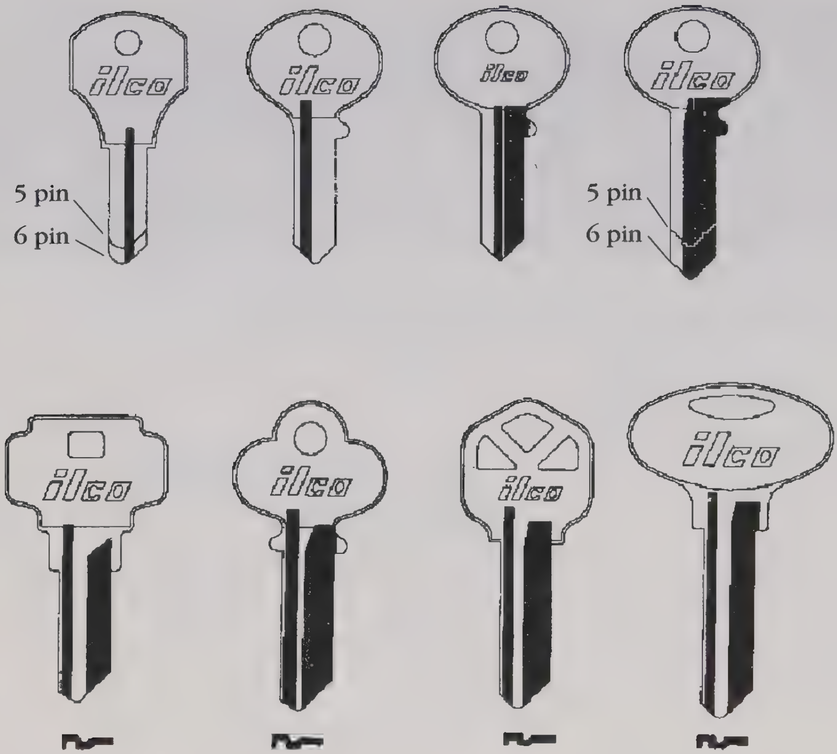
Pin tumbler keys

Pin tumbler keys are usually manufactured of brass and sometimes are nickel plated on the outside. Most are paracentric in design, meaning that certain wards, lands, or grooves are milled into their sides to allow them to enter into a pin tumbler plug that has been broached out to accept these particular types of milled keys (Figs. 9-8 and 9-9).

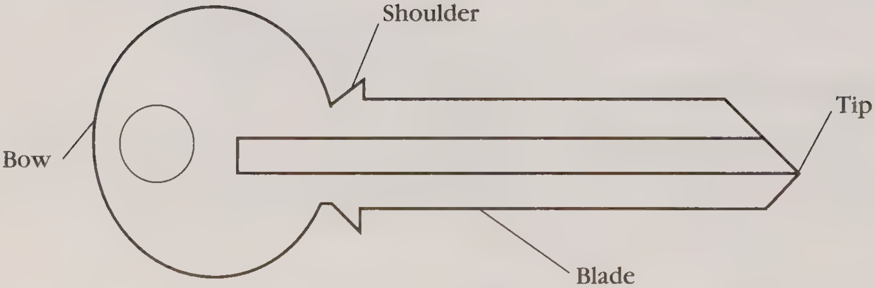
Pinning and rekeying

To rekey a pin tumbler lock, the cylinder must be removed from the lock. The procedures used to remove the cylinder will vary depending on the style of lock (mortise, rim, key-in-knob, etc.). The rekeying procedure, however, is basically the same. The following tools are needed to rekey most standard pin tumbler cylinders:

- plug followers
- pin tweezers
- shims
- pin tumbler pinning kits
- screwdrivers: small, slotted, or phillips
- awl or nail



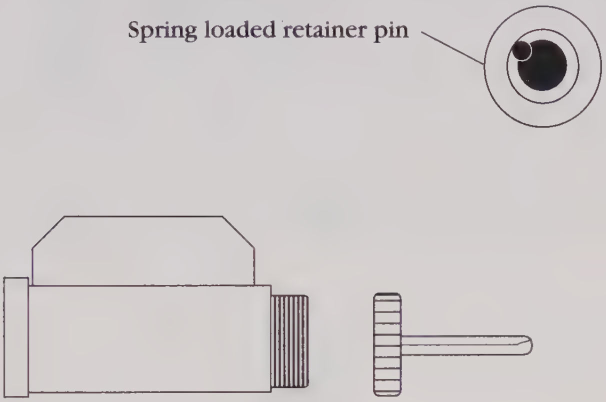
9-8 Typical pin tumbler keys. Accredited Lock Supply Co.



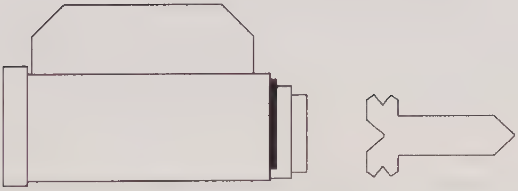
9-9 The parts of a pin tumbler key.

Follow these steps to rekey a key-in-knob pin tumbler cylinder with the proper key.

1. Remove the entire cylinder assembly from the lock.
2. Move the cylinder retaining cap and tailpiece to the back of the plug, or the two small screws that hold the cam to the back of the plug if it is a mortise cylinder (Fig. 9-10). In some cylinders, you must press down the spring-loaded retaining pin in order to unscrew the retaining cap.



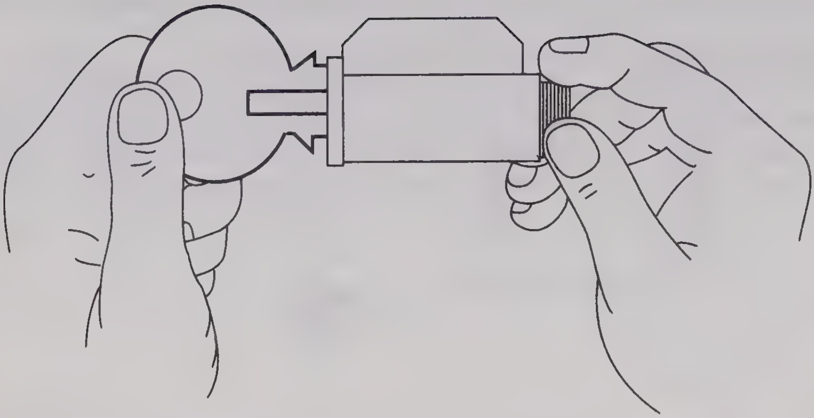
Plug retaining cap type



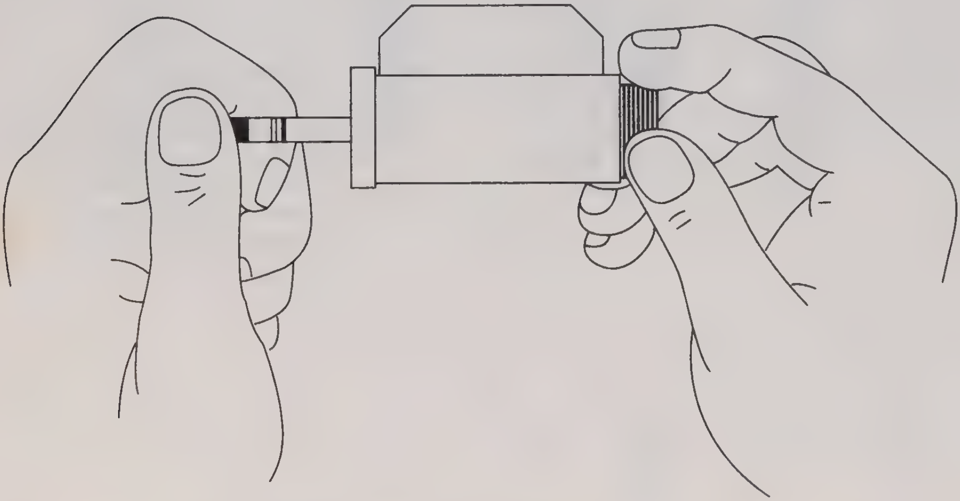
Plug retaining ring type

9-10
Two types of key-in-knob cylinders and their retainers. One has a cap that must be screwed off, the other has a retaining ring that must be snapped off.

3. Hold the cylinder in one hand and insert the key into the plug with the other hand while applying slight pressure to keep the plug from slipping out of the cylinder shell (Fig. 9-11).
4. Turn the key one-quarter turn, being careful not to let the plug slide out (Fig. 9-12).
5. Butt the plug follower (of appropriate diameter) up against the rear of the plug at the rear of the cylinder shell (Fig. 9-13).



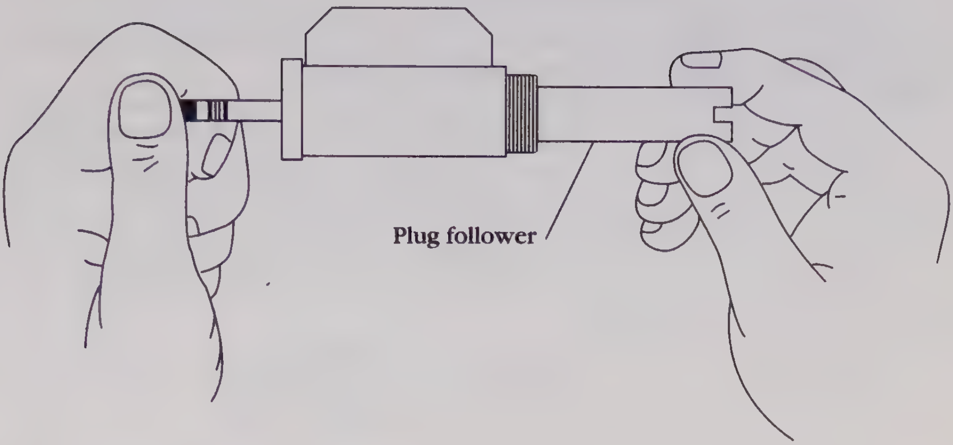
9-11 Inserting the proper key, with retainer cap removed.



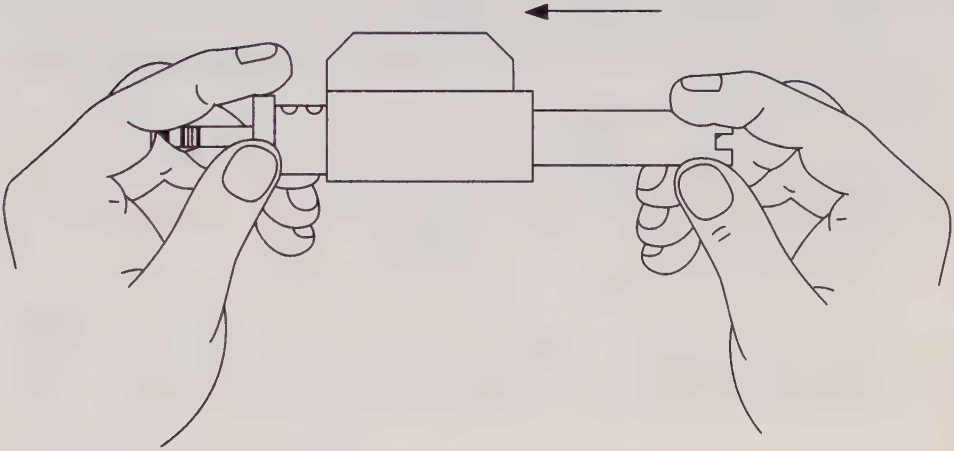
9-12 Key turned ¼ turn. Pressure must be held to prevent the plug from falling out.

6. Apply pressure against the plug follower with the plug, and slowly push the plug out of the cylinder with the plug follower (Fig. 9-14).
7. When the plug clears the cylinder shell, push the plug follower in a little more, and then lay the cylinder shell aside with the plug follower in it (Fig. 9-15).
8. Lay the plug down and remove the key and pins.

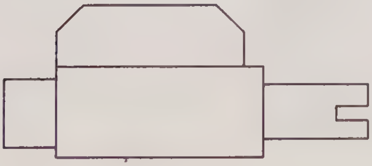
Note: The plug follower keeps the drivers and springs inside the chambers of the cylinder shell and facilitates the easy removal and installation of the plug.



9-13 Plug follower butted up to plug rear.



9-14 Plug follower pushing plug out of cylinder housing.



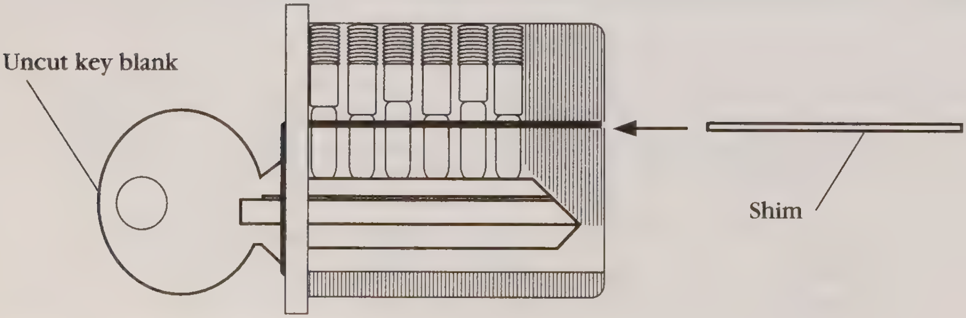
9-15
Plug follower remains in cylinder housing.

To rekey the lock:

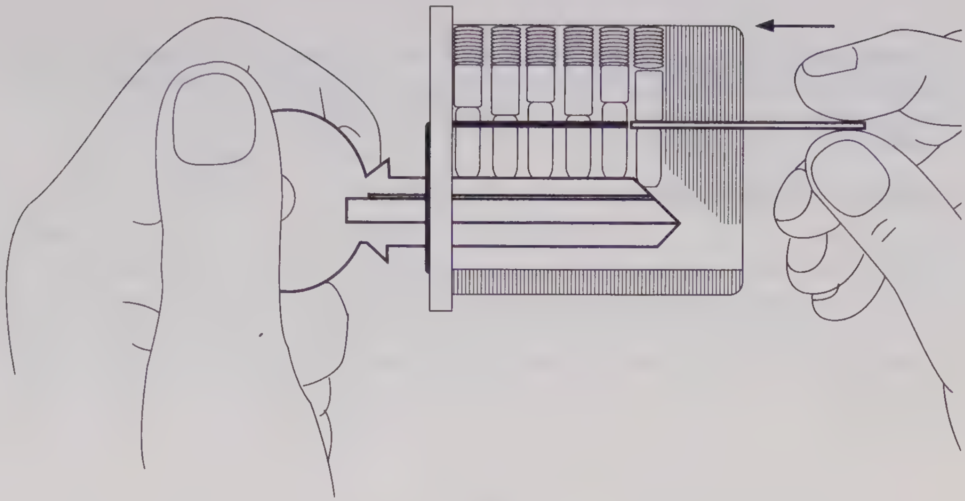
1. Place the new key into the lock. This can be a previously cut key or a key that was purposely cut by code for this cylinder.
2. Place the appropriate size pins into each chamber of the plug and make sure that the top of each pin lies perfectly flush with the top circumference of the plug. You can find the proper size bottom pins using eyesight, or you can pin according to the code information stamped on the key bow.
3. Insert the plug, with the key still in it, back into the cylinder by reversing the removal procedure. Make sure the plug is turned one-quarter turn before you insert it. You can do this by turning the cylinder shell one-quarter turn in your hand.
4. Push the plug all the way in and remove the plug follower.
5. While holding the cylinder shell with one hand and the key with the other, turn the plug back one-quarter turn to the locking position.
6. Test the plug for proper operation. Turn the key one-quarter turn one way or the other while you hold the entire assembly to prevent the plug from slipping out.
7. If the cylinder operates properly, turn the plug back to the locked position, remove the key, and reinstall the cam, the retaining ring tailpiece, or the retaining cap. If the cylinder does not operate properly or smoothly, remove the plug, and then rekey with the proper size pins.

Follow these procedures to rekey a pin tumbler cylinder using shims when you don't have the proper key.

1. Remove the cylinder from the lock.
2. Remove the cam or tailpiece.
3. Place an uncut key blank all the way into the lock.
4. Slide a metal shim into the space between the cylinder shell and plug at the rear of the cylinder and at the shearline (Fig. 9-16).
5. While slightly pushing the shim into the cylinder, slowly remove the key blank. This procedure allows the shim to separate the top and bottom pins. The bottom pins will ride up and down on the tip of the key blank. As the space between each top and bottom pin aligns with the shim, the shim will separate them and then push further into the cylinder (Fig. 9-17).



9-16 Shows where to insert shim.



9-17 Shim separates top and bottom pin at shearline.

6. Continue this procedure until all the top pins are separated from the bottom pins. When this happens, the plug will rotate slightly.
7. Turn the plug one-quarter turn and then remove the key.
8. Remove the shim.
9. Place the plug follower at the rear of the plug and then follow the previous directions for removing the plug from the lock.
10. Follow the regular procedure for rekeying and reinstalling the cylinder.

Tip: When you use a shim, wiggle the key back and forth or slightly sideways to help separate the top and bottom pins.

Replacing and servicing top pins

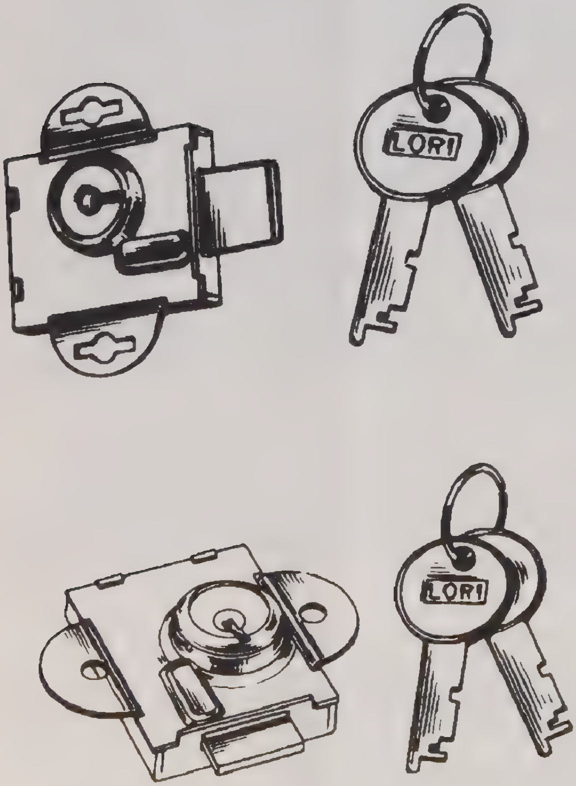
Some locksmiths always replace, or at least lubricate, the top pins and springs when they rekey a pin tumbler lock. This procedure ensures a completely repacked cylinder and avoids operational difficulties caused by problem drivers or springs. Follow these procedures to replace and service top pins.

1. Remove the plug using the preceding procedures.
2. Remove each top pin and spring by slowly pushing the plug follower out of the cylinder shell. Do this slowly because each top pin is under pressure from the spring above it. The top pin and spring will "shoot out."
3. With a pin tweezers, insert each new spring and top pin into the chambers one at a time. After you push the top pin down into the chamber, slide the plug follower over the pin to counter the pressure applied by the spring. This will keep the pins in place. You can work from one end to the other, or you can do a few chambers from one end, slide the plug follower down, and then work from the other end of the plug back to the center of the shell.
4. After you are done, use the procedures previously outlined to replace the plug.

Note: Instead of replacing all the top pins and springs you can also lubricate the existing ones by adding a small pinch of graphite to the inside of each shell chamber and then replacing the original top pins and springs.

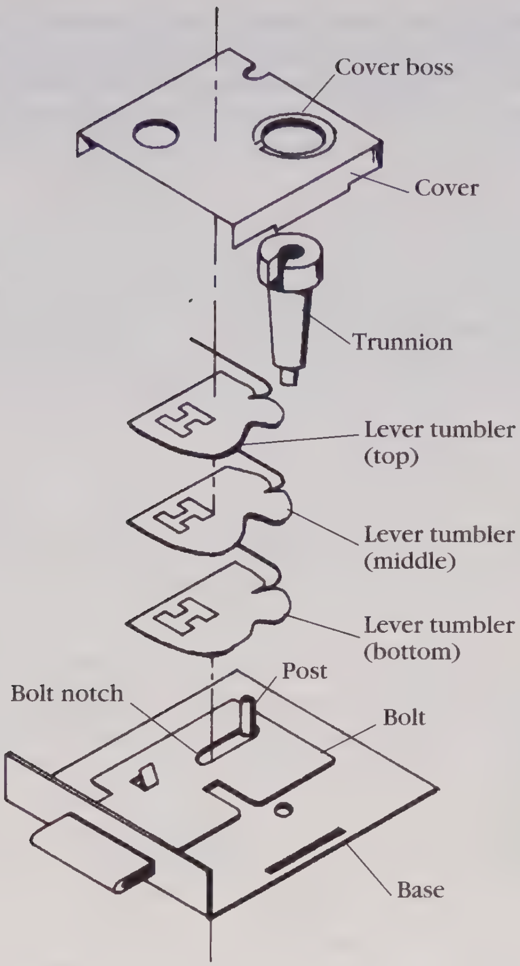
LEVER TUMBLER LOCKS

Lever tumbler locks are built and operate much differently than the conventional and more popular pin tumbler lock. Although they have their place in high-security applications, such as safe deposit boxes with a double-set tumbler design, they are used mostly for applications that allow a more lenient state of security. Today, they are used mostly for mailboxes, luggage, lockers, and other light security applications (Fig. 9-18).



9-18
Two lever tumbler mail box locks.

Figure 9-19 shows the basic construction of a lever tumbler lock. Most lever tumbler lock cases are flatter in design, more compact, take up less space, and easily adapt to small storage cabinets and boxes. Their biggest disadvantage, however, is that they do not allow for as many master-key combinations as pin tumbler locks.



9-19
Parts of a lever tumbler mail box lock.

Operation

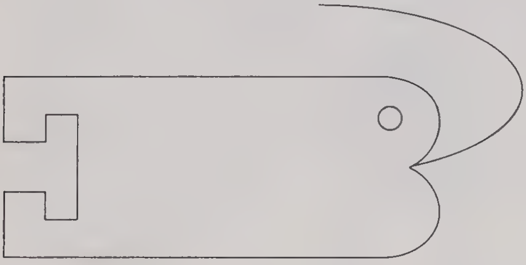
In a basic, fixed, lever tumbler lock design, the entire lock is enclosed in a case (Fig. 9-19). The simple lever lock has three or more lever tumblers that pivot on a post and are pushed into the "locking" position by springs, which are bound against the case and attached to the tail end of each lever tumbler. When the proper key is inserted into the lock and turned, it raises each tumbler to the point where the *fence* of the lock's bolt can clear the obstruction or *face*, of each tumbler, which also blocks each tumbler's *gate*. When all the tumblers are in this position, the fence can be thrown through each tumbler's gate, which pushes the bolt into the retracted position.

In other lever lock designs, a post is connected directly to the bolt. With the lever tumbler lock, when the tumblers are raised to the proper position the post of the bolt will pass through the front gating to the rear gating and hold the bolt in the retracted position.

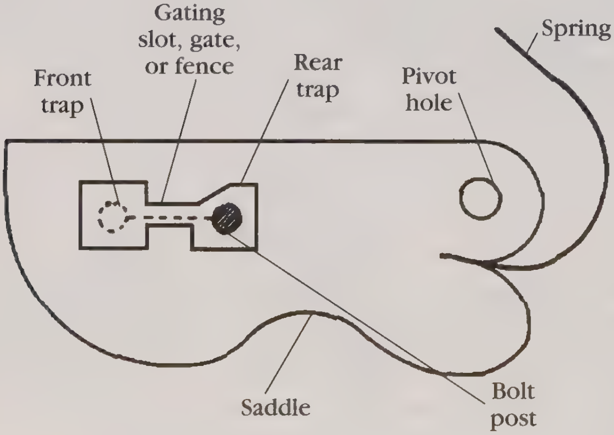
There are two different ways that the lever lock bolt can be thrown. In some lever locks, the *end*, or uncut, portion of the key that acts as a bolt throw will make contact with a bolt throw notch cut into the bolt. The other method is to use a trunnion with a talon built on the bottom of it. In both instances, when the key is turned contact is made with the bolt throw notch of the bolt, which allows it to be retracted.

Tumbler designs

Different types of lever locks have different tumbler designs. Figure 9-20 shows a simple lever tumbler with one gate. This type of tumbler relies on the obstruction built onto the face or front of the tumbler and its tumbler trap to lock the bolt into either the locked or unlocked position. Figure 9-21 shows the type of lever tumbler that uses a front and rear gate to trap the bolt into either position.



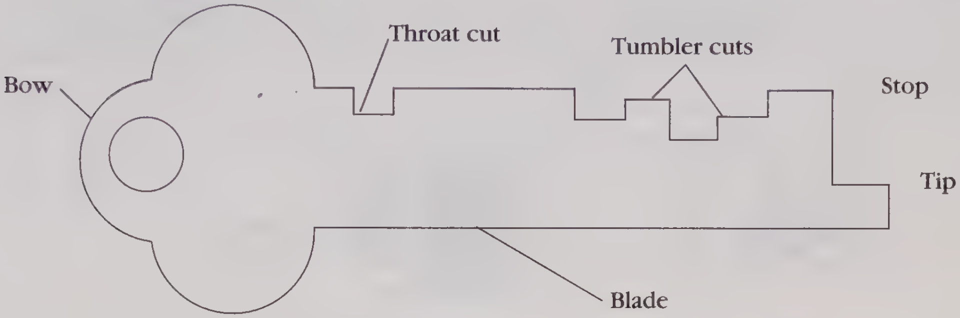
9-20
Lever tumbler with a single gate.



9-21 Lever tumbler with two gates.

Some lever tumblers have serrated saddles, or *bellies*, others have false gates. These varying designs make it more difficult to pick a lever tumbler lock. Lever tumblers with false gates usually are reserved for high-security units.

The lever lock key is much different than that for a pin tumbler lock. It is a flat steel key that must be cut with a special steel-cutting blade. The key is constructed of steel because of the force that must be applied to the lever tumblers to open the lock (Fig. 9-22).



9-22 The lever tumbler flat steel key.

DISK TUMBLER LOCKS

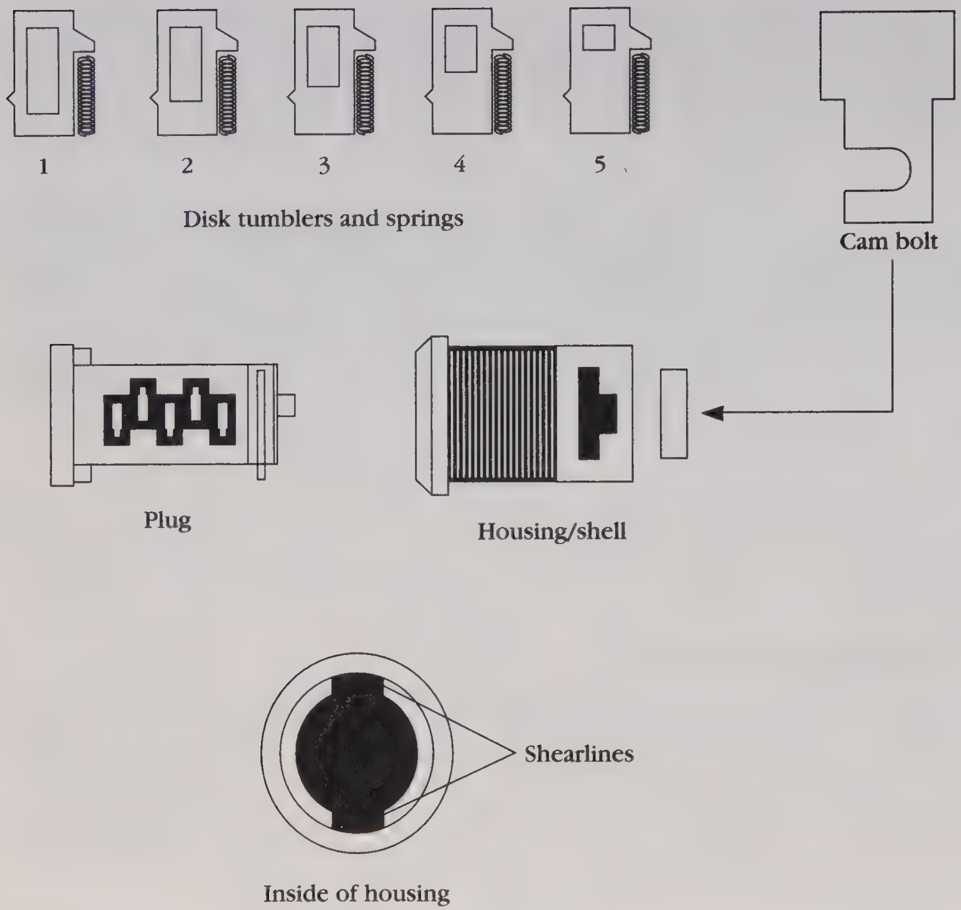
The disk tumbler lock is used frequently, usually in automotive, furniture, tool, and desk and cabinet locks. In some situations, like in the case of the double-sided disk tumbler, its security effectiveness is sometimes considered high security. There are other reasons for its widespread use, one of which is its multi-camming functions. The rear cam of the disk tumbler lock can have its rotation adjusted and limited to the four common degree rotations found in these types of locks: 45 degrees, 90 degrees, 180 degrees, and 360 degrees.

Construction

Figure 9-23 shows the basic construction of a disk tumbler or wafer lock. The main parts of a disk tumbler lock are the plug, shell, cam, springs, disk tumblers, stop pin, and plug retainer, which is usually built into the end of the plug itself. The operational functions of the disk tumbler lock are different from those of the pin or lever tumbler lock. Instead of the key contacting either the bottom or side of the tumbler, the key enters into the keyway and makes contact with the tumbler at a hole, or rectangle, that is cut into the center of the tumbler and draws the tumbler up or down into the plug.

Basic operation

In the basic disk tumbler design, the plug itself contains the disk tumblers, springs, and plug retainer. The disk tumblers sit into grooves that have been cut out of the plug itself. To supply tension, the tumblers are connected to springs that sit into the ends of the tumblers' chambers. The springs keep the disks from falling out of the plug and also keep them above the top, or shearline, of the plug. This is also

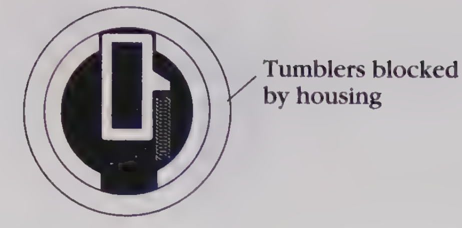


9-23 Parts of a common disk tumbler desk lock.

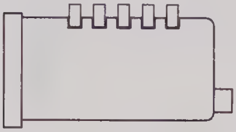
what keeps the lock locked. You can see in Fig. 9-24 how the tumblers sit normally when the plug is encased in the shell. Plug rotation is prevented when the disk tumblers hit up against the top sides of the shell. To open the lock, the key must be inserted so that it pulls down each disk tumbler to a point where they all sit flush with shearline of the plug (Fig. 9-25).

Double-sided disk lock operation

In a double-sided disk lock, tumblers are staggered in the plug. Some disks protrude through the top of the plug, others protrude through the bottom of it. This arrangement creates two shearlines and requires the use of a special, double-sided key blank. In the double-sided disk design, both shearlines must be cleared before the plug will rotate. This requires that cuts be made on both the top and bottom of the key (Fig. 9-26).

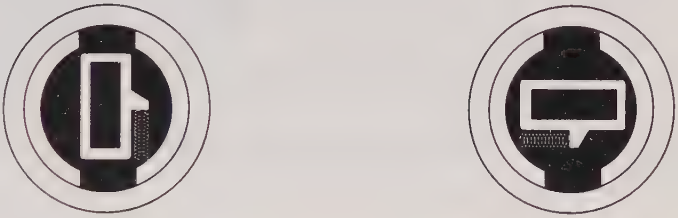


Wafers protrude past plug shearline



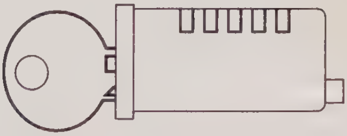
No key inserted

9-24 Shows disk tumblers and how they sit when no key is inserted into the lock cylinder.



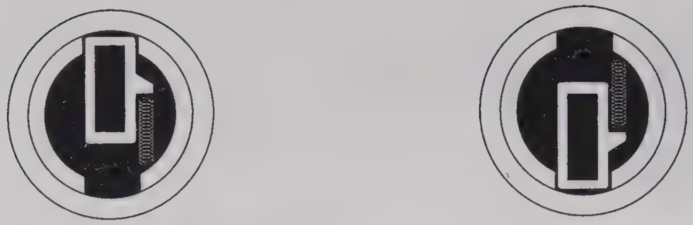
Tumblers clear housing obstacle

Plug turned 1/4 turn



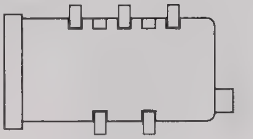
Tumblers flush out at plug shearline

9-25 Shows the relation of tumblers to the lock housing when the proper key is inserted. Also shows tumbler position with key turned ¼ of a turn.



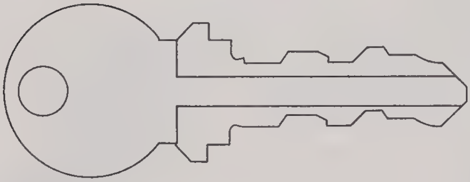
First tumbler

Second tumbler



No key inserted

Wafers protrude past plug shearlines



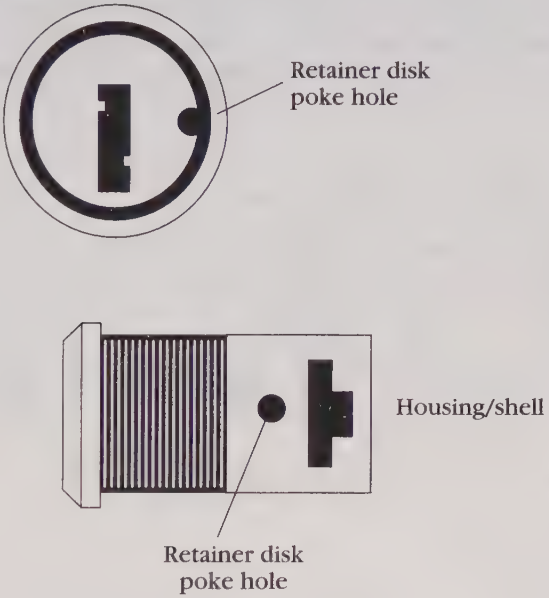
Double-sided disk tumbler key

9-26 A double-sided disk tumbler plug and double-sided disk tumbler key.

Rekeying with the proper key

To rekey a disk tumbler lock, you do not always have to remove the entire cylinder. Although some situations might call for its complete removal, most service can be accomplished by removing only the plug. In some instances, however, the cam at the back of the lock will have to be removed in order to pull out the plug. Other locks, manufactured by different companies, require that the retaining wafer be pushed down after the plug has been rotated in order to allow the removal of the plug. Many of these locks have their cam pieces that slip into the top of the cylinder casing (at the rear) from either the top or bottom. Some of these locks have poke holes that allow you to access the retaining wafer from the outside of the cylinder shell. Others can be accessed through a poke hole cut into the front of the plug. In some situations it might be easier to pick the lock plug open by accessing the retaining wafer through the key hole. Follow these procedures to rekey a disk tumbler lock when you have the proper key.

1. Remove the cam at the back of the lock. Most of the cams are secured to the rear of the plug either by a screw and tension washer or/and by a U-shaped clip. Some are not, and therefore are not removed.
2. Insert the proper key, turn it to the left or right, and then remove the plug.
   a. If necessary, place a stiff piece of thin wire through the poke hole at the front of the plug, or at the access hole at the side rear of the cylinder. Some of these poke holes are at the top or bottom, some are on the sides.
   b. Press down the retaining wafer with the wire and pull out the plug (Fig. 9-27).



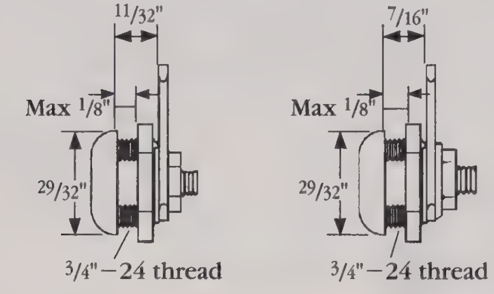
9-27
Shows location of poke holes in double-sided disk tumbler lock cylinders.

   c. Pick the lock open by raking the wafers and turning the plug with a tension tool. Place a hook pick into the back of the plug and push down on the retaining wafer. Pull the plug out.
3. Once the plug is removed, take out each wafer by pulling up on them with a tweezers. Some wafers are staked in so tightly you might actually have to use a small screwdriver or awl, or even a pair of needle nose pliers, to pull them out.
4. Place new disk tumblers into the chambers. Use tumblers that correspond to the cuts stamped onto the key bow you will be using, or fit the proper size wafers through trial and error using a previously cut key with no code on it. A more thorough method, however, would be to decode the cuts on the key using a dial caliper and a spacing and depth chart to determine the proper size tumblers to put into each chamber.
5. Test the accuracy of the pinning. All the wafers, when the key is fully inserted, should lower into the plug and flush out at both the top and bottom shearlines.

6. Place the plug back into the cylinder by pushing down on the retaining wafer. This allows the plug to enter almost all the way into the cylinder.
7. Slowly rotate the plug until the cam contact post on the back of the plug slips into the groove cut into the bottom of the cam. You will know this has been accomplished when the face of the plug "clicks" into the cylinder all the way, and when the face of the plug lies flush with the outside of the cylinder face. This will also allow proper operation of the cam.

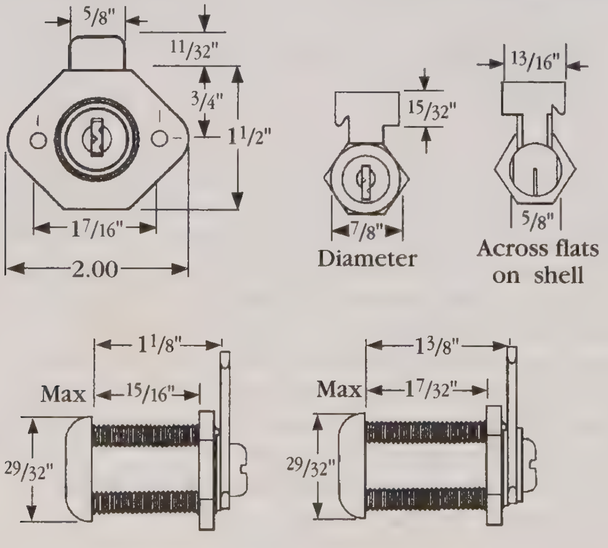
Note: Some locksmiths drill a small access hole into the side of the rear casing, right about where the retaining wafer will lie, in case they have trouble pulling down on the retainer through the plug's front poke hole. This procedure is not suggested. Picking the wafers to the open position is better. If an emergency situation makes it necessary to drill such a hole, exercise extreme caution in order not to damage the small tolerance clearing between the plug and inside cylinder shell.

Figure 9-28 shows a few of the various types of disk tumbler cam locks manufactured by different companies. Figure 9-29 shows the different cam sizes and

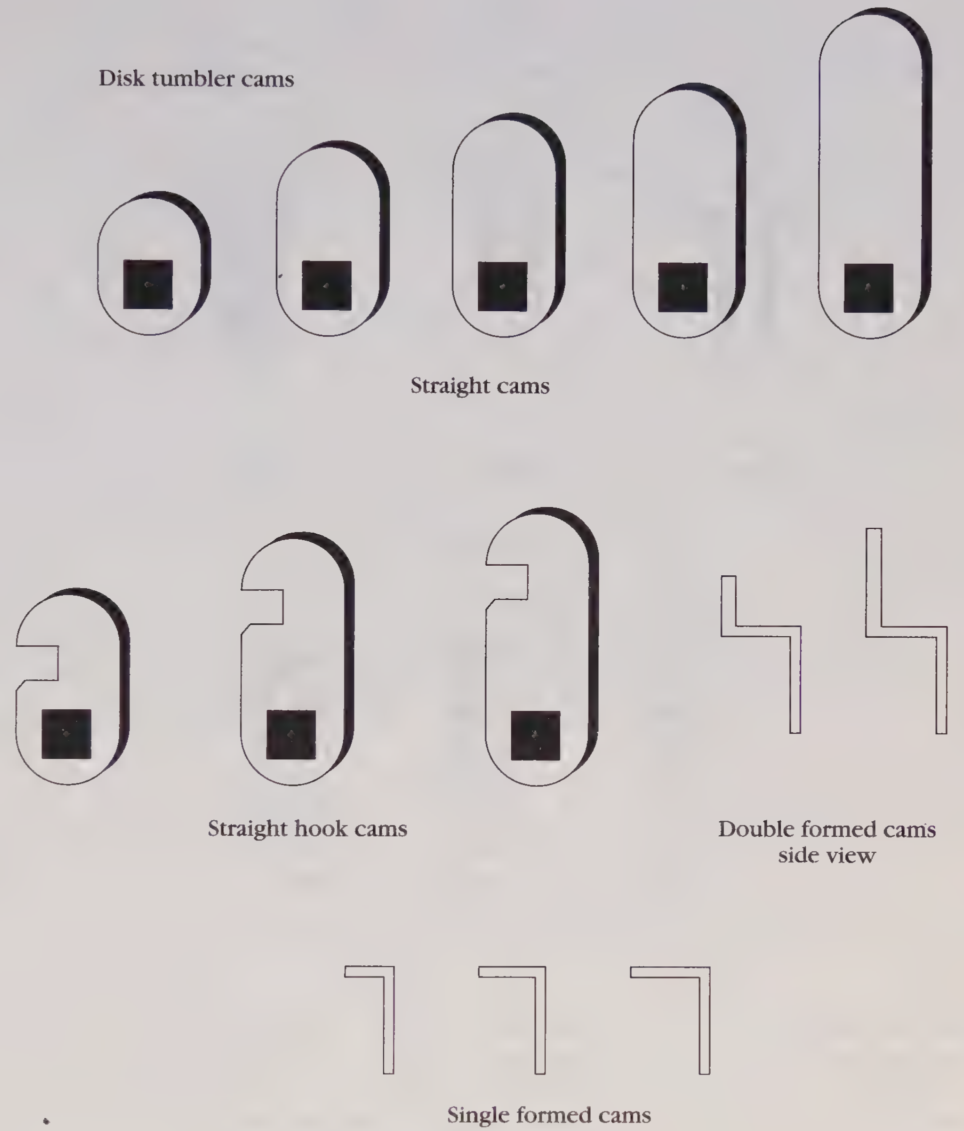


Wood desk locks

Metal drawer lock



9-28 Various sizes and shapes of disk tumbler locks. Accredited Lock Supply Co.



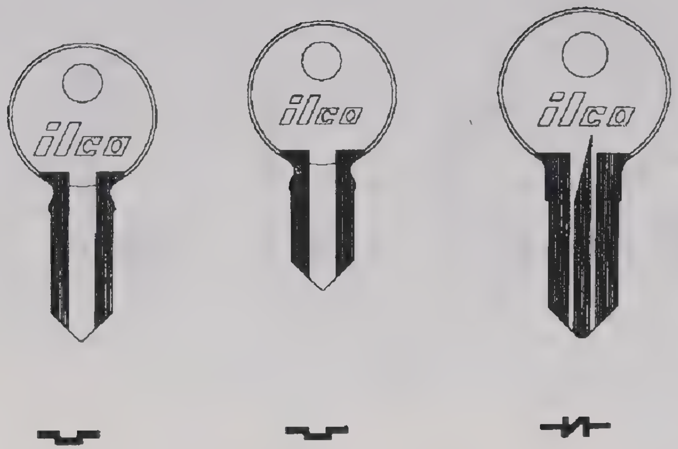
9-29 Various cam types and sizes for National disk tumbler locks. Accredited Lock Supply Co.

shapes available for different models. Figure 9-30 shows a few more typical, double-sided disk tumbler keys.

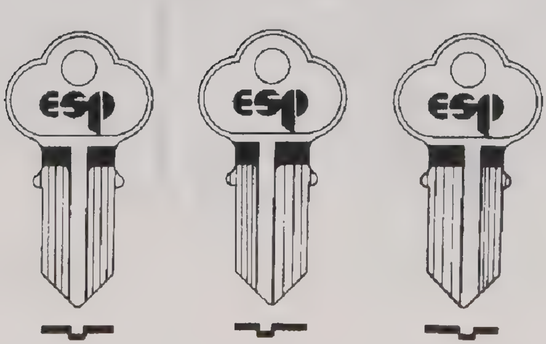
WARDED LOCKS

Warded locks are one of the oldest locks known to man. Their existence dates back to the Romans. The principle behind the warded lock, however, makes it one of the most insecure locks of all time. They are sometimes referred to as *bit key* locks, and

Illinois



Chicago locks

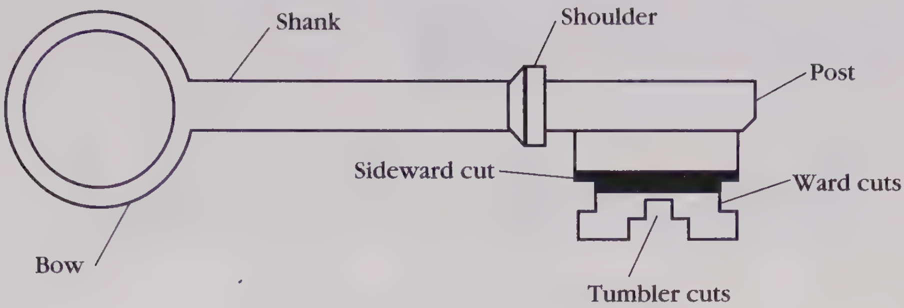


9-30 Common double-sided disk tumbler keys. Accredited Lock Supply Co.

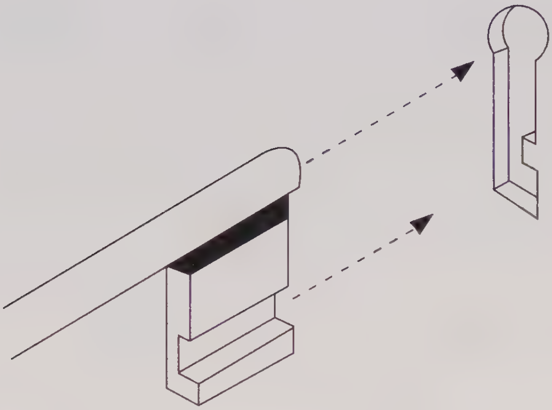
can still be found mostly on interior doors in old apartment buildings. At present, they are rarely used for new locking applications.

The term *ward* refers to an obstruction, or a set of obstructions, inside the keyway or on the inside cover of the warded lock. By placing these wards in a certain way, the key is prevented from either entering into the keyway or from turning in the keyway at all (Fig. 9-31). The basic parts of this type of lock are the lever tumbler, lever tumbler spring, hub, deadbolt, and latchbolt.

This type of warded lock has a door spindle that enters into the lock's hub. This enables the lock's latchbolt to be operated by simply turning the door knob, thus supplying passageway function. The deadbolt can only be thrown into the locked position with the proper key, or one in a series of keys designed to bypass warded keyways. The locking action was enabled by a lever tumbler that blocked the retraction of the deadbolt. When the proper key is inserted, the lever tumbler is raised, which enables it to clear the blocking portion of the deadbolt tailpiece.



9-31a A ward (bit) key.



9-31b
A keyhole with a ward, and the cut placed into the blade to bypass it.

10

Lock designs and functions

The previous chapter discussed types of locks, in technical terms relating to the internal pinning construction of lock cylinders. This information is required to determine the servicing, rekeying, and bypassing procedures needed. There is another way to refer to locks: by describing the design, installation, and function of the lock. When a locksmith speaks to a customer over the phone, he or she will most likely ask the customer to describe how the lock is installed in the door, piece of furniture, structure, or equipment. This description provides the locksmith with a clue as to the design of the lock.

The six most common lock designs are mortise, key-in-knob, rim, tubular deadlock, combination, and combination or keyed padlock. Other common locks are:

automotive
bicycle
cabinet
cargo
cam
chain
computer
deadlocks
desk
drawer
electronic fence
file cabinet
freezer
furniture
garage door
gate
gun
hood
interchangeable core
jimmy-proof
keyless
king pin
lever handle
locker magnetic
mail box
outboard motor
patio door
pushbutton
roll-up door
safe deposit
safety lockout
screen door
screw type
showcase
ski
sliding door
sliding gate
steering
steering wheel
store door
swinging gate
switch
T-shaft
T-handle
threaded shaft
trailer
truck body
utility
vending machine
vent window
window

It is easy to determine from this long list how the description of a lock can take on an altogether different meaning. Usually the object on which the lock is mounted is added to the lock's name. These names are called *layman's terms*. But if you closely examine each of the previously named locks, you will notice that many of them are similar to the four basic lock designs mentioned earlier.

For instance, many cabinet and furniture locks are disk or pin tumbler locks. Most safe deposit box locks are lever tumbler locks. Almost all of the layman's-term locks are pin tumbler locks. Many locks, such as the safe deposit box lock, are used for only one application, so it can be said that many locks are manufactured and utilized for a specific application.

LOCK FUNCTIONS

One of the most important locksmithing skills is to understand lock functions: what a particular model is and is not supposed to do. For instance, if a store owner calls you and tells you that his or her storeroom lock opens from the outside without a key, you would know that the lock was not operating correctly and needed to be serviced. Why? Because every locksmith worth his or her key blank dust knows that a storeroom lock always has an outside rigid knob that does not rotate and can only be opened with a key from the outside.

Figures 10-1 and 10-2 include popular lock functions recognized by the American National Standards Institute (ANSI) and accepted and followed by most manufacturers of architectural locking mechanisms and associated hardware, although the

Non-Keyed Locks

SCHLAGE ANSI

L9010 F01 **Passage Latch**

Latchbolt retracted by lever or knob from either side at all times.

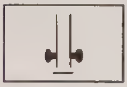
L9040 F22 **Bath/Bedroom Privacy Lock**

Latchbolt retracted by lever or knob from either side unless outside is locked by inside turn piece. Operating inside lever or knob or closing door unlocks outside lever or knob. *To unlock from outside, remove emergency* button, insert turn piece (furnished) in access hole and rotate.

L0170 **Single Dummy Trim**

Lever or knob on one side fixed by mounting bar.

L0172 **Pair Dummy Trim**



Lever or knob on both sides fixed by mounting bar.

L9175 **Single Dummy Trim**

Lever or knob on one side fixed. Includes lock chassis and armor front.

L9176 **Pair Dummy Trim**

Lever or knob both sides fixed. Includes lock chassis and armor front.

Keyed Locks

SCHLAGE ANSI

L9050 F04 **Office and Inner Entry Lock**

Latchbolt retracted by lever or knob from either side unless outside is made inoperative by key outside or by rotating inside turn piece. When outside is locked, latchbolt is retracted by key outside or by lever or knob inside. Outside lever or knob remains locked until thumbturn is returned to vertical or by counter clockwise rotation of key. Auxiliary latch deadlocks latchbolt when door is closed.

L9060 F09 **Apartment Entrance Lock**

Latchbolt retracted by lever or knob from either side unless outside is locked by key from inside. When locked, latchbolt retracted by key outside or lever or knob inside. Auxiliary latch deadlocks when door is closed.

L9070 F05 **Classroom Lock**

Latchbolt retracted by lever or knob from either side unless outside is locked by key. Unlocked from outside by key. Inside lever or knob always free for immediate exit. Auxiliary latch deadlocks latchbolt when door is closed.

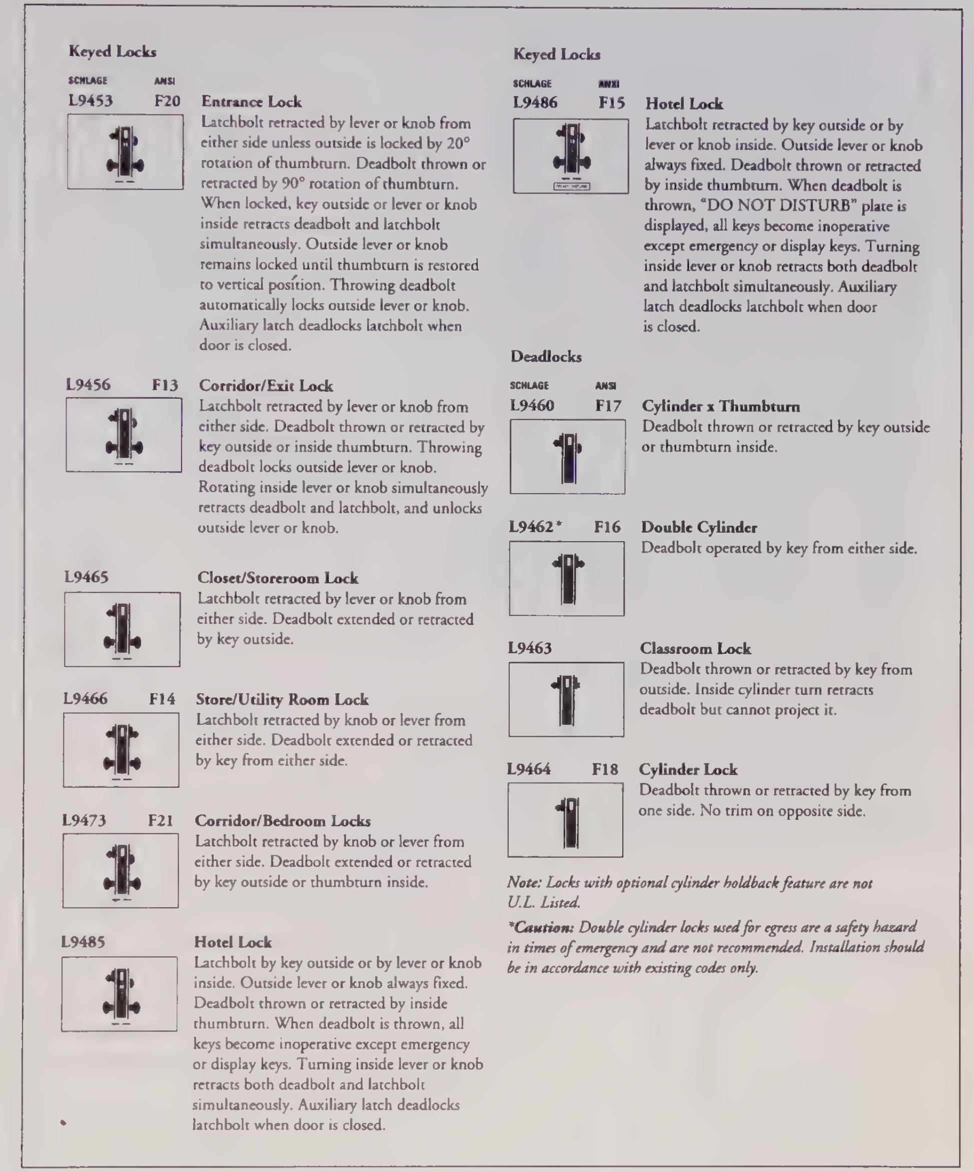
L9080 F07 **Storeroom Lock***

Latchbolt retracted by key outside or by lever or knob inside. Outside lever or knob always inoperative. Auxiliary latch deadlocks *latchbolt when door is closed.*

L9082 **Institution Lock**

Latchbolt retracted by key from either side. Lever or knob on both sides always inoperative. Auxiliary latch deadlocks latchbolt when door is closed.

10-1 Shows the most common functions of mortise locks. Schlage Lock Co.



Keyed Locks

SCHLAGE	ANSI	Function
L9453	F20	**Entrance Lock** Latchbolt retracted by lever or knob from either side unless outside is locked by 20° rotation of thumbturn. Deadbolt thrown or retracted by 90° rotation of thumbturn. When locked, key outside or lever or knob inside retracts deadbolt and latchbolt simultaneously. Outside lever or knob remains locked until thumbturn is restored to vertical position. Throwing deadbolt automatically locks outside lever or knob. Auxiliary latch deadlocks latchbolt when door is closed.
L9456	F13	**Corridor/Exit Lock** Latchbolt retracted by lever or knob from either side. Deadbolt thrown or retracted by key outside or inside thumbturn. Throwing deadbolt locks outside lever or knob. Rotating inside lever or knob simultaneously retracts deadbolt and latchbolt, and unlocks outside lever or knob.
L9465		**Closet/Storeroom Lock** Latchbolt retracted by lever or knob from either side. Deadbolt extended or retracted by key outside.
L9466	F14	**Store/Utility Room Lock** Latchbolt retracted by knob or lever from either side. Deadbolt extended or retracted by key from either side.
L9473	F21	**Corridor/Bedroom Locks** Latchbolt retracted by knob or lever from either side. Deadbolt extended or retracted by key outside or thumbturn inside.
L9485		**Hotel Lock** Latchbolt by key outside or by lever or knob inside. Outside lever or knob always fixed. Deadbolt thrown or retracted by inside thumbturn. When deadbolt is thrown, all keys become inoperative except emergency or display keys. Turning inside lever or knob retracts both deadbolt and latchbolt simultaneously. Auxiliary latch deadlocks latchbolt when door is closed.

Keyed Locks

SCHLAGE	ANSI	Function
L9486	F15	**Hotel Lock** Latchbolt retracted by key outside or by lever or knob inside. Outside lever or knob always fixed. Deadbolt thrown or retracted by inside thumbturn. When deadbolt is thrown, "DO NOT DISTURB" plate is displayed, all keys become inoperative except emergency or display keys. Turning inside lever or knob retracts both deadbolt and latchbolt simultaneously. Auxiliary latch deadlocks latchbolt when door is closed.

Deadlocks

SCHLAGE	ANSI	Function
L9460	F17	**Cylinder x Thumbturn** Deadbolt thrown or retracted by key outside or thumbturn inside.
L9462*	F16	**Double Cylinder** Deadbolt operated by key from either side.
L9463		**Classroom Lock** Deadbolt thrown or retracted by key from outside. Inside cylinder turn retracts deadbolt but cannot project it.
L9464	F18	**Cylinder Lock** Deadbolt thrown or retracted by key from one side. No trim on opposite side.

Note: Locks with optional cylinder holdback feature are not U.L. Listed.

**Caution:* *Double cylinder locks used for egress are a safety hazard in times of emergency and are not recommended. Installation should be in accordance with existing codes only.*

10-2 More mortise lock functions. Schlage Lock Co.

functions might vary from manufacturer to manufacturer. It should be understood that all manufacturers allow the functions of most of their lock models to be modified by adding or taking out specific parts.

MORTISE LOCKS

Mortise locks are installed into the mortised-out edging of a door (Fig. 10-3). Mortise locks, depending on the model, might have a small number of moving parts or

Marks USA Inc.

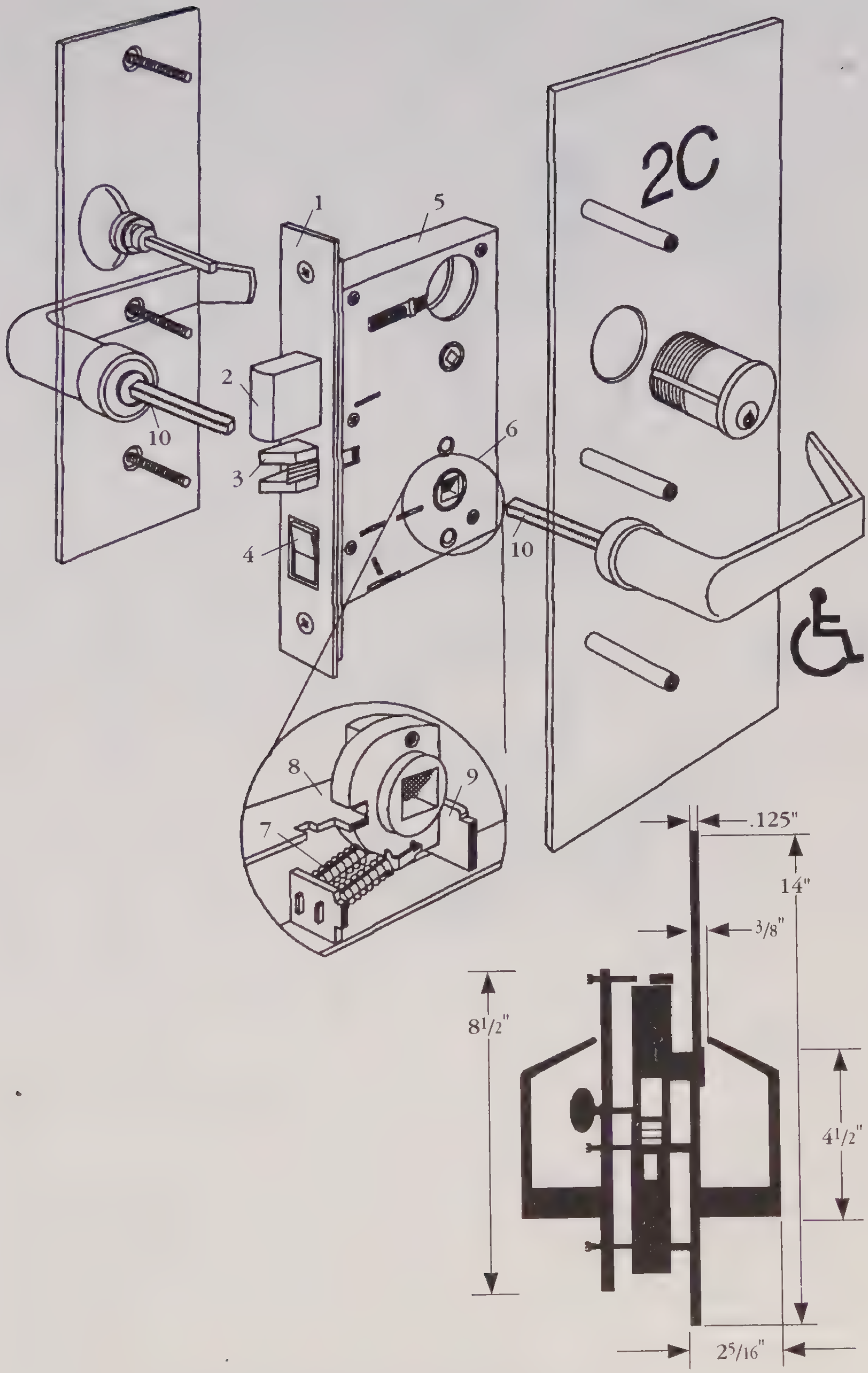
10-3
A mortise lock with latch and deadbolt.

many, depending on the number of functions that it must perform. Mortise locks for entrance doors usually incorporate a latchbolt and a deadbolt. Most mortise locks use either knobs or lever-type handles. Many mortise locks are handing reversible, meaning that on-site they can be switched from a right-hand operation to a left-hand operation. Locks of this type are important because they allow the installer to quickly compensate for doors that are either right-hand hung, or left-hand hung. Some manufacturers make mortise locks with functions that can be changed easily by adding extra parts (Figs. 10-1 and 10-2). Mortise locks can be installed in homes, apartments, hospitals, office buildings, schools, and almost everywhere else. They are supplied in light-duty, medium, commercial, and heavy-duty models.

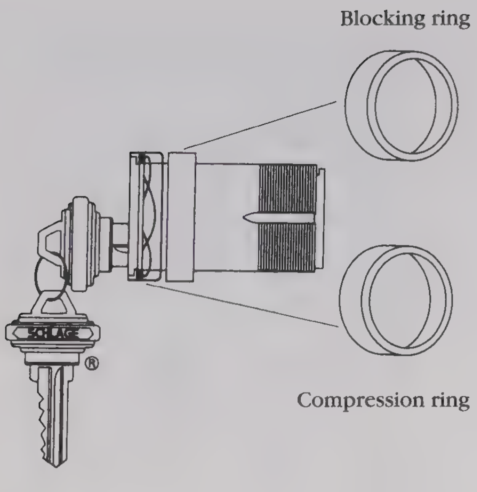
Basic construction and operation

Figure 10-4 shows the basic construction and parts of a mortise entrance lock. Like all mortise locks, the deadbolt is activated by inserting a key through the mortise cylinder. Figure 10-5 shows a basic mortise cylinder.

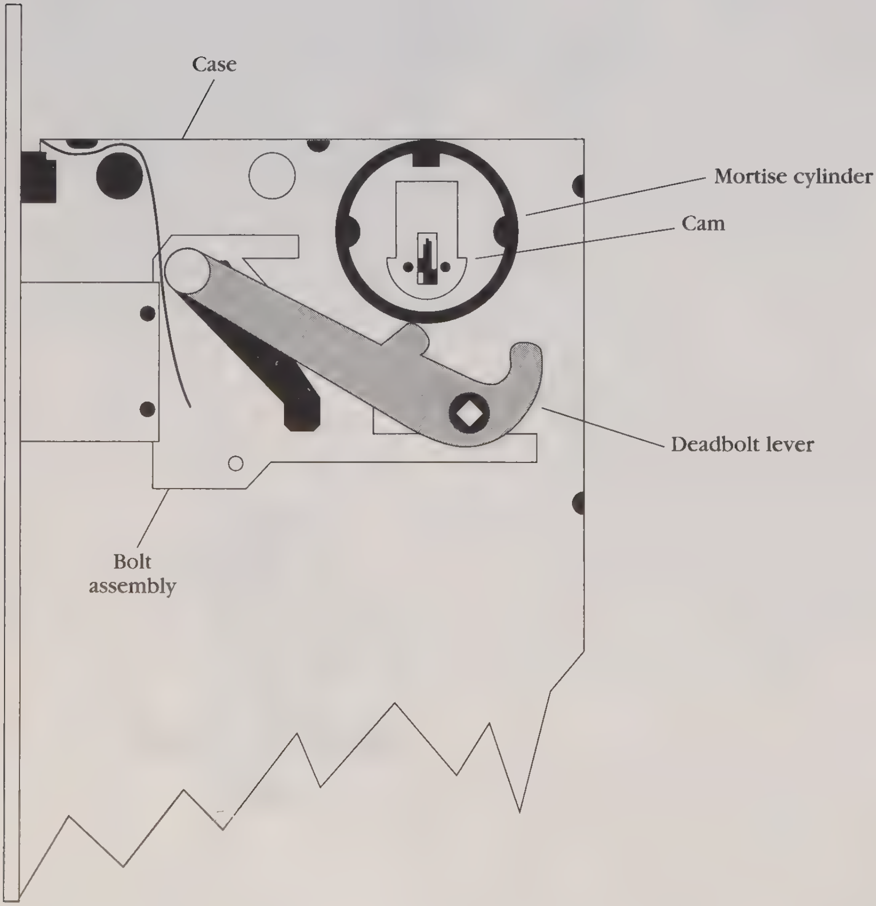
In a typical mortise lock design, the deadbolt lever retracts or locks into place the deadbolt portion of the lock. This lever is usually kept in place by a spring, one end of which sits against one corner of the mortise case and the other end against the deadbolt lever (Fig. 10-6). The deadbolt lever is key activated by a cam that is



10-4 The parts of a typical apartment entry lockset. Marks USA Inc

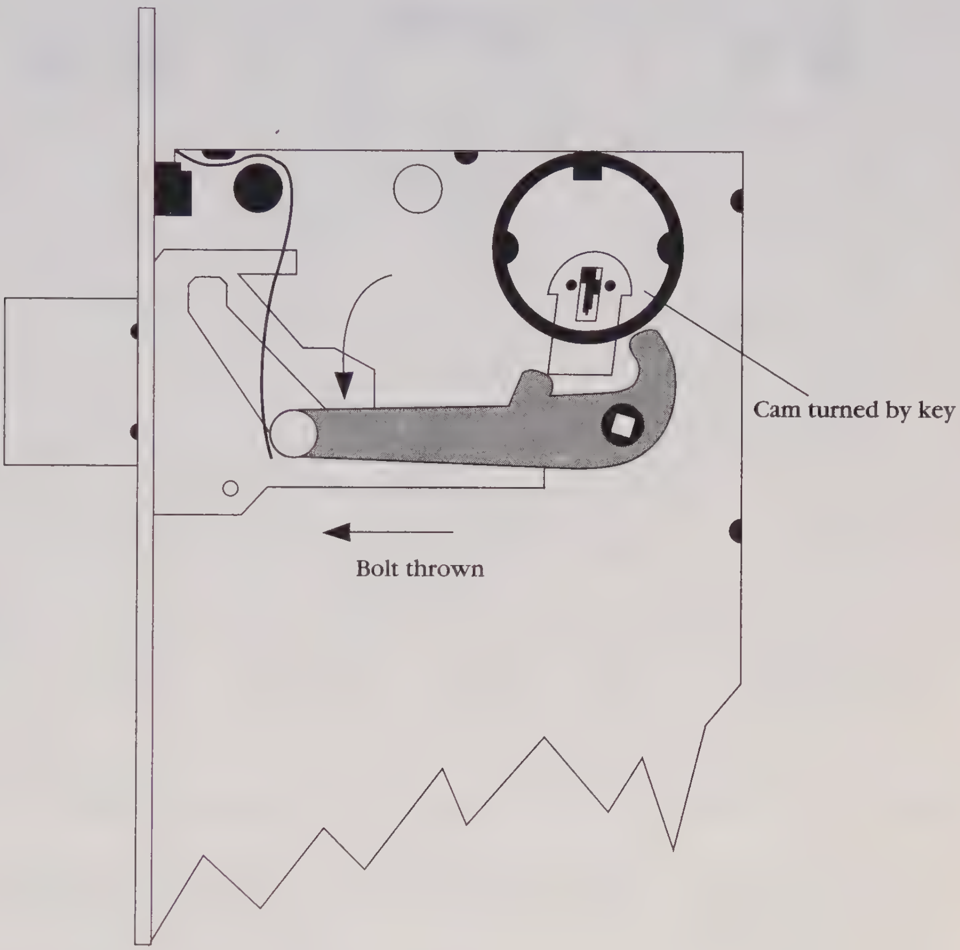


10-5 A mortise cylinder with a blocking and compression ring. Schlage Lock Co.



10-6 A deadbolt lever holding the bolt assembly in the unlocked position.

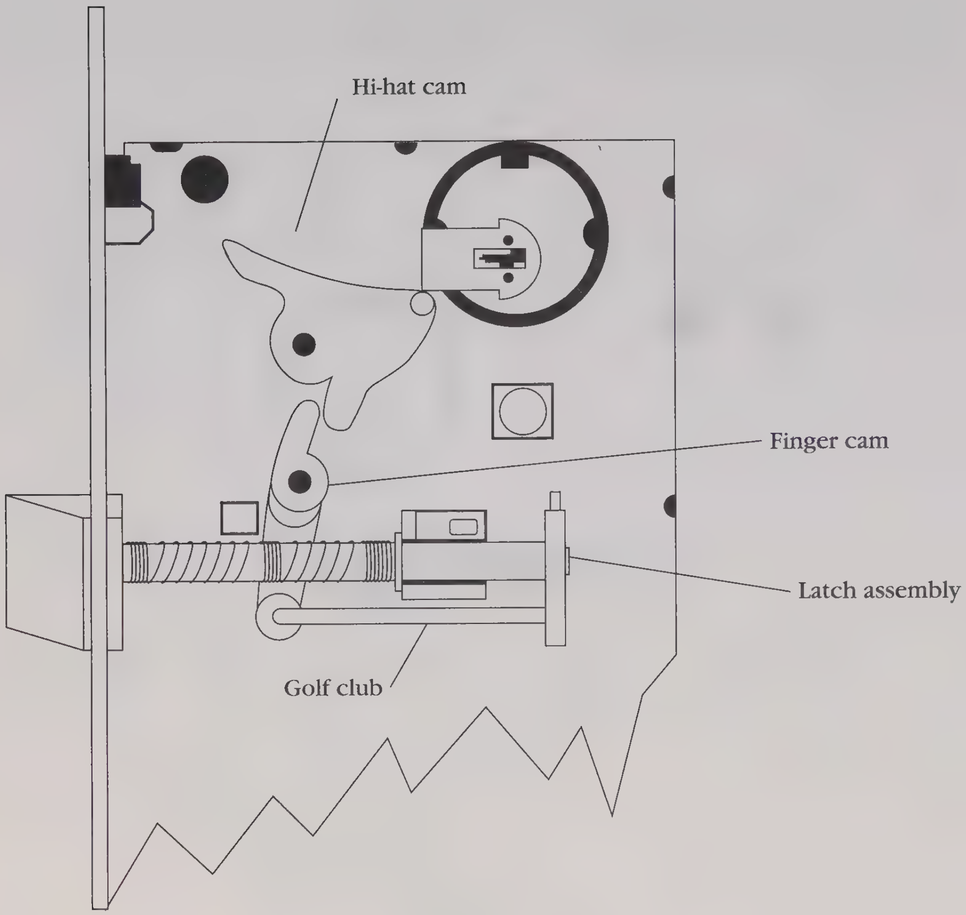
connected to the back of the mortise cylinder. Or it can be activated using a thumb turnpiece with a post that slips into the lock casing and then into the pivot post on the deadbolt lever (Fig. 10-7).



10-7 The deadbolt thrown into the locked position.

The spring latch can be retracted one of two ways. It can be retracted by knob and spindle, which turns the male or female hub, or it can be retracted by turning the key one-quarter turn. When both the deadbolt and the spring latch are in the locked position both can be turned at once by turning the key one-and-one-quarter turns (Figs. 10-8 and 10-9). Figure 10-10 shows the hub and hub-lever assemblies.

To free or lock up either the inside or the outside knob, a rocker switch is pushed at its top or bottom. When pushed at the bottom, the rocker switch pushes in a follower, which in turn slips into the male hub, or the one that faces the outside of the door. This prevents the outside knob from supplying latchbolt activation.



10-8 Hi-hat cam activated by the mortise cylinder cam, which in turn activates the finger cam.

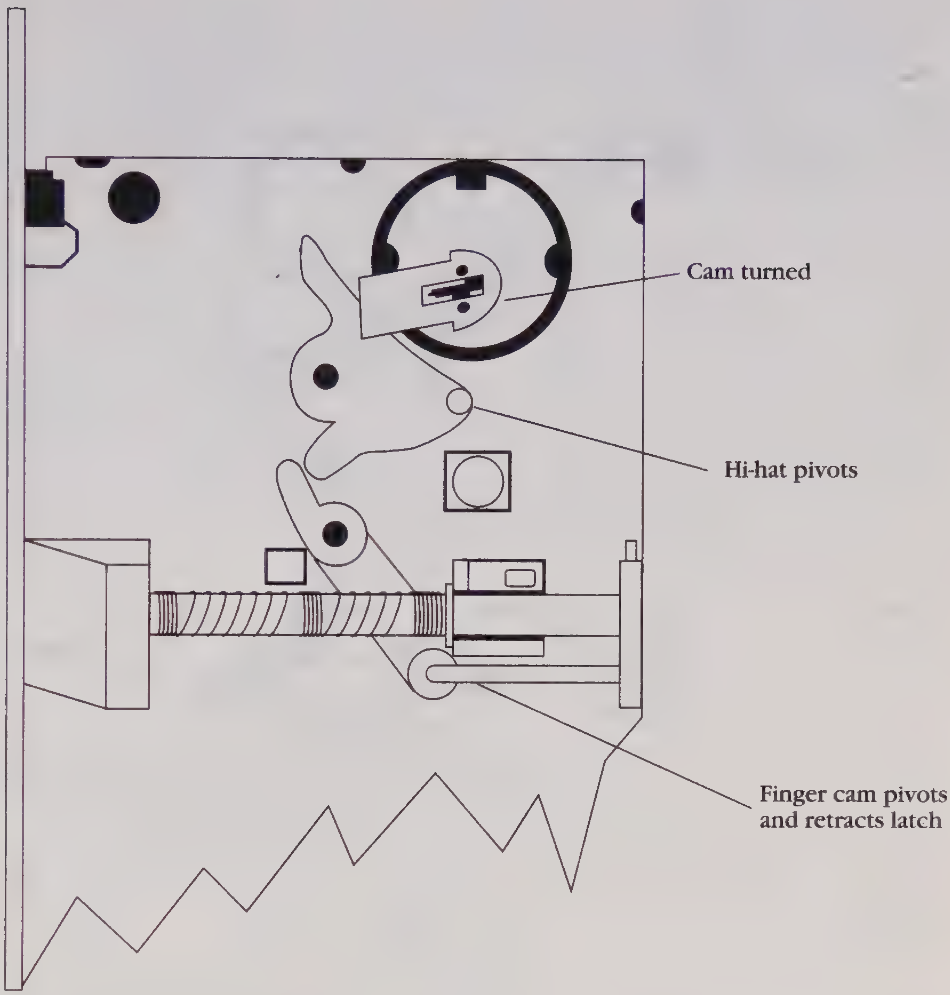
Many mortise locks are handing reversible. Most of them can have the handing changed by taking out the latch assembly, reversing it, and then reinstalling it. Other locks, like the Schlage L Series mortise locks, can be changed by pulling the latch bolt away from the casing and then revolving it 180 degrees (Fig. 10-11).

One advantage to mortise locks is that they offer two types of locking mechanisms in one unit: auxiliary deadbolt locking and standard latching.

KEY-IN-KNOB LOCKS

Key-in-knob locks are cylindrical-shaped locks that fit into round bored holes. Their cylinders are housed in one or both knobs. The more popular entrance model has a keyed knob on the outside and a pushbutton or turnknob on the inside (Fig. 10-12).

Like the mortise lock, most key-in-knob locks are designed for residential, light-duty, medium-duty, commercial, and heavy-duty commercial applications. There are literally hundreds of key-in-knob designs, such as the ones shown in Fig. 10-13.

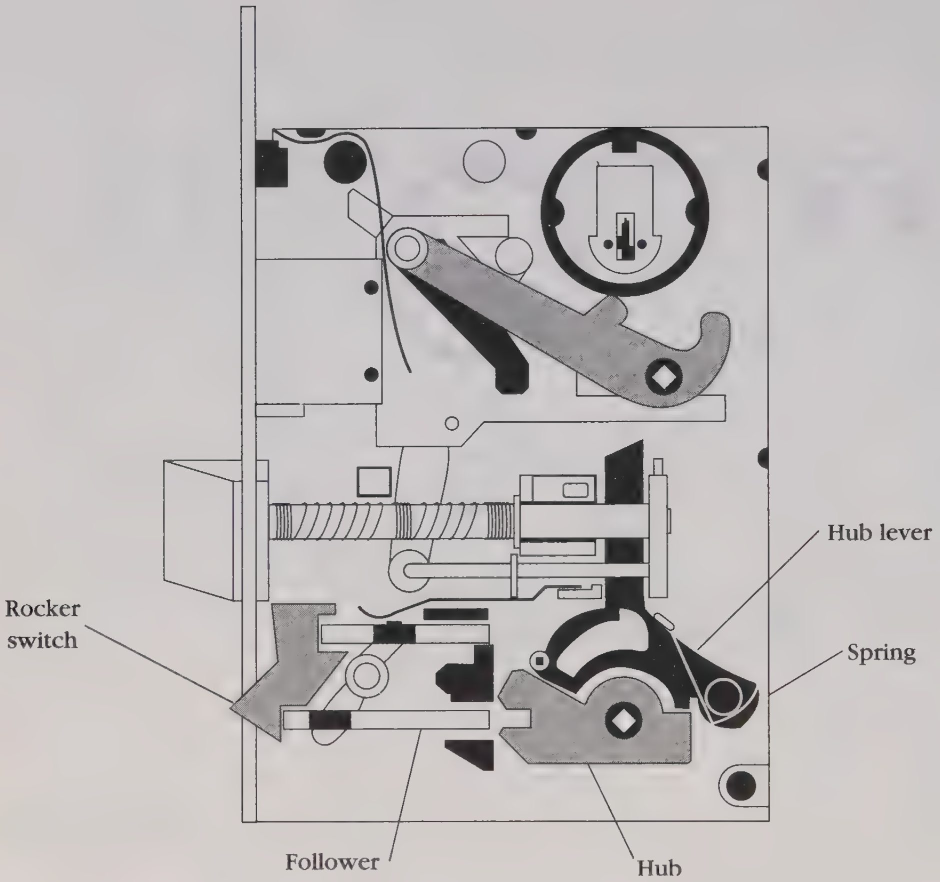


10-9 The latchbolt being retracted into the lock case.

Basic construction and operation

Some key-in-knob locks are complicated and intricate in design and operation. This makes for a heavy-duty lock that can withstand great force and be used over a long period of time.

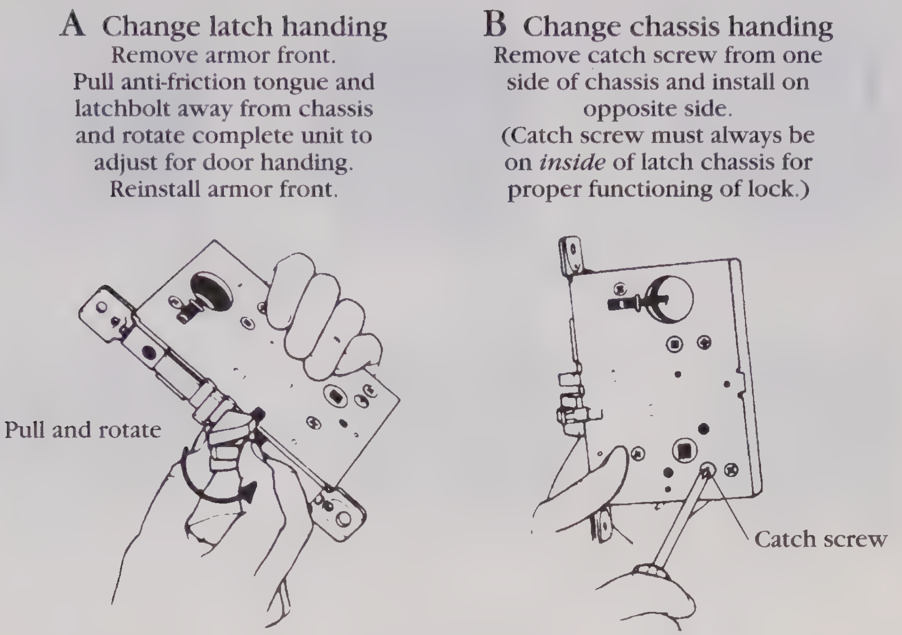
Figure 10-14 shows the parts of a Schlage A Series entrance lock. Both sides of this particular brand have a spindle that slips into a central housing and frame. Both the inside and outside knobs connect to the spindles. They are locked in place by a small knob retainer that is built onto both spindles. An outside cam piece (item 11 in Fig. 10-15) is the only connection between the internal parts that sit inside the outside knob. Figure 10-15 also shows a key-in-knob cylinder (notice the tailpiece). Notice in the trim-assembly drawing how all the trim parts are fitted, including the knobs, inside and outside rose, and mounting plates.



10-10 Shows all the parts inside a typical entrance mortise lock.

Shown in the assembled chassis of the Schlage A Series entrance lock are the main latching mechanisms (item 13: the slide; and items 14, 15, and 15a: the spring slide, the seat spring, and the springs). The outside and inside spindles lock into this entire assembly, which connects to the latch and is what causes the latch to move in and out.

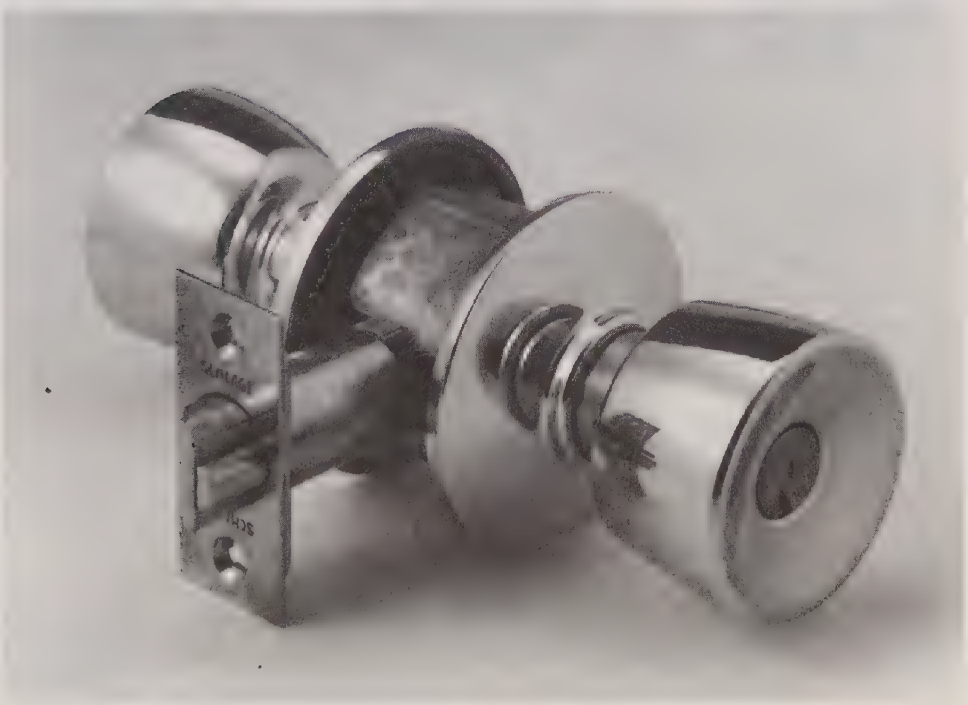
Some key-in-knob locks have simpler designs (Fig. 10-16). In the simpler locks, an adjustable latching unit and half spindle that connects to the knob assembly serves as the complete mechanism for retracting the latch bolt. Handing is also adjustable on many key-in-knob locks. To switch from a right-hand to a left-hand application, the lock casing is taken out and revolved so that the latch mechanism faces toward the latch bore. Then the cylinders are removed from the knobs and turned around. A properly installed key-in-knob cylinder will have its broaching on the bottom portion of the cylinder. This is where the key enters into the keyway of the plug. The key cuts must always face upward. This prevents the weight of the drivers and the bottom pins from weighing down on the cylinder springs, which would ultimately cause spring fatigue and improper operation (Fig. 10-17). Figure 10-18 shows some additional functions of key-in-knob locks.



A Change latch handing
Remove armor front.
Pull anti-friction tongue and latchbolt away from chassis and rotate complete unit to adjust for door handing.
Reinstall armor front.

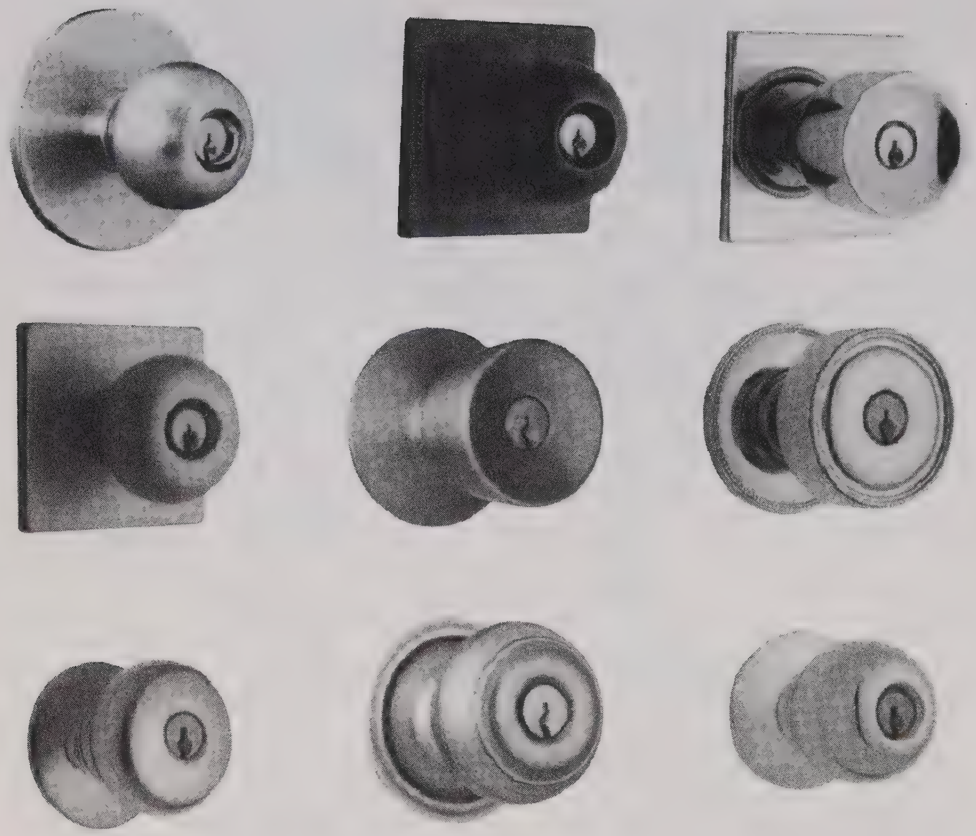
B Change chassis handing
Remove catch screw from one side of chassis and install on opposite side.
(Catch screw must always be on *inside* of latch chassis for proper functioning of lock.)

10-11 Schlage's L-Series mortise lock hand changing. Schlage Lock Co.



Schlage Lock Co

10-12 A Schlage F-Series key-in-knob lock.



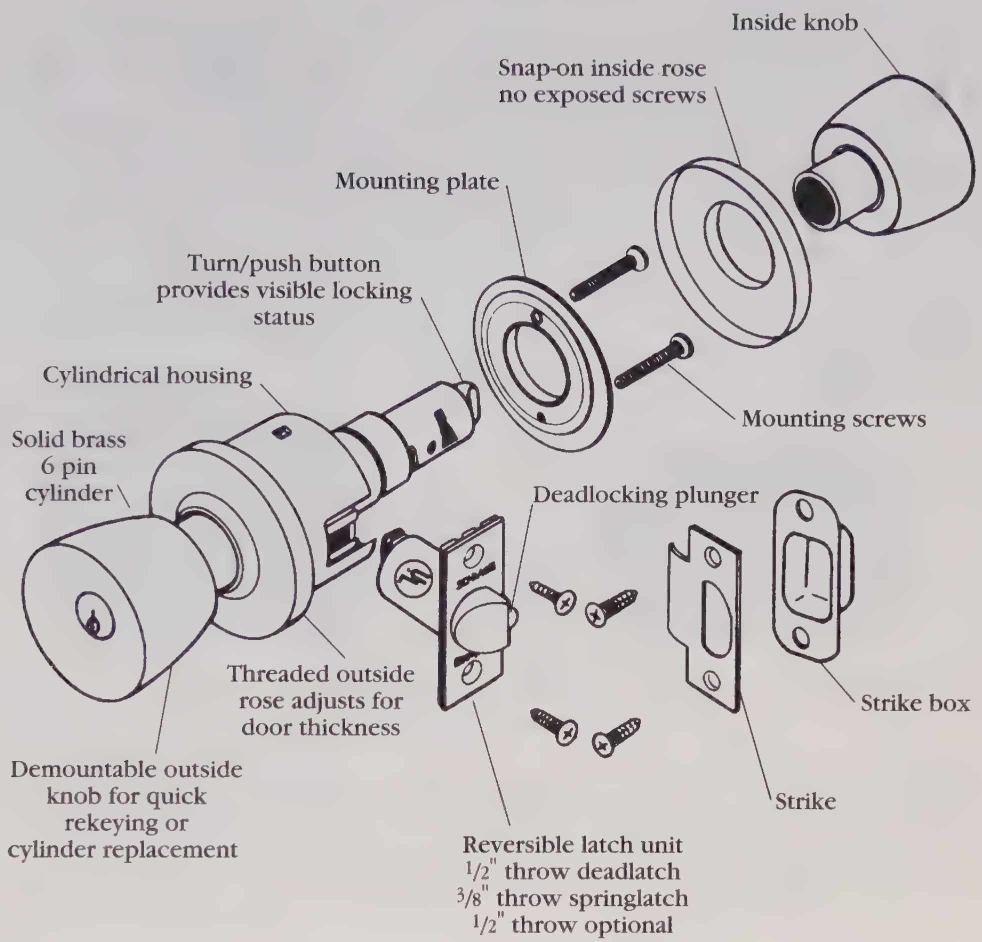
10-13 Various key-in-knob designs. Schlage Lock Co.

RIM LOCKS

Rim locks are installed on the surface of a door (Fig. 10-19). Rim locks usually are used as auxiliary locking units, meaning that they are installed to add on to the security of a door that usually already has a mortise or a key-in-knob lock installed on it. Rim locks can be installed on wood, metal, or calamine doors. The most common type of rim lock is the vertical deadbolt lock, like the one shown in Fig. 10-20. These locks have a pin tumbler cylinder that is installed on the outside surface of the door and is considered a separate component of the lock. First the cylinder is installed on the door and then the lock. For this reason, any rim lock cylinder, from standard to high-security, can be used with most rim locks.

Basic construction and operation

Figure 10-21 shows the internal parts of a standard rim lock. Because of their simplicity of operation, they do not contain many parts. A deadbolt lever, which is held in place by spring tension, locks the deadbolt in either the up or down position. The lever itself is activated either by the thumb turnpiece, a cylinder cam, or a cylinder tailpiece that slips into a shutterguard at the back of the lock. The cover plate be-


Inside knob
Snap-on inside rose no exposed screws
Mounting plate
Turn/push button provides visible locking status
Cylindrical housing
Solid brass 6 pin cylinder
Mounting screws
Deadlocking plunger
Threaded outside rose adjusts for door thickness
Strike box
Demountable outside knob for quick rekeying or cylinder replacement
Strike
Reversible latch unit
1/2" throw deadlatch
3/8" throw springlatch
1/2" throw optional

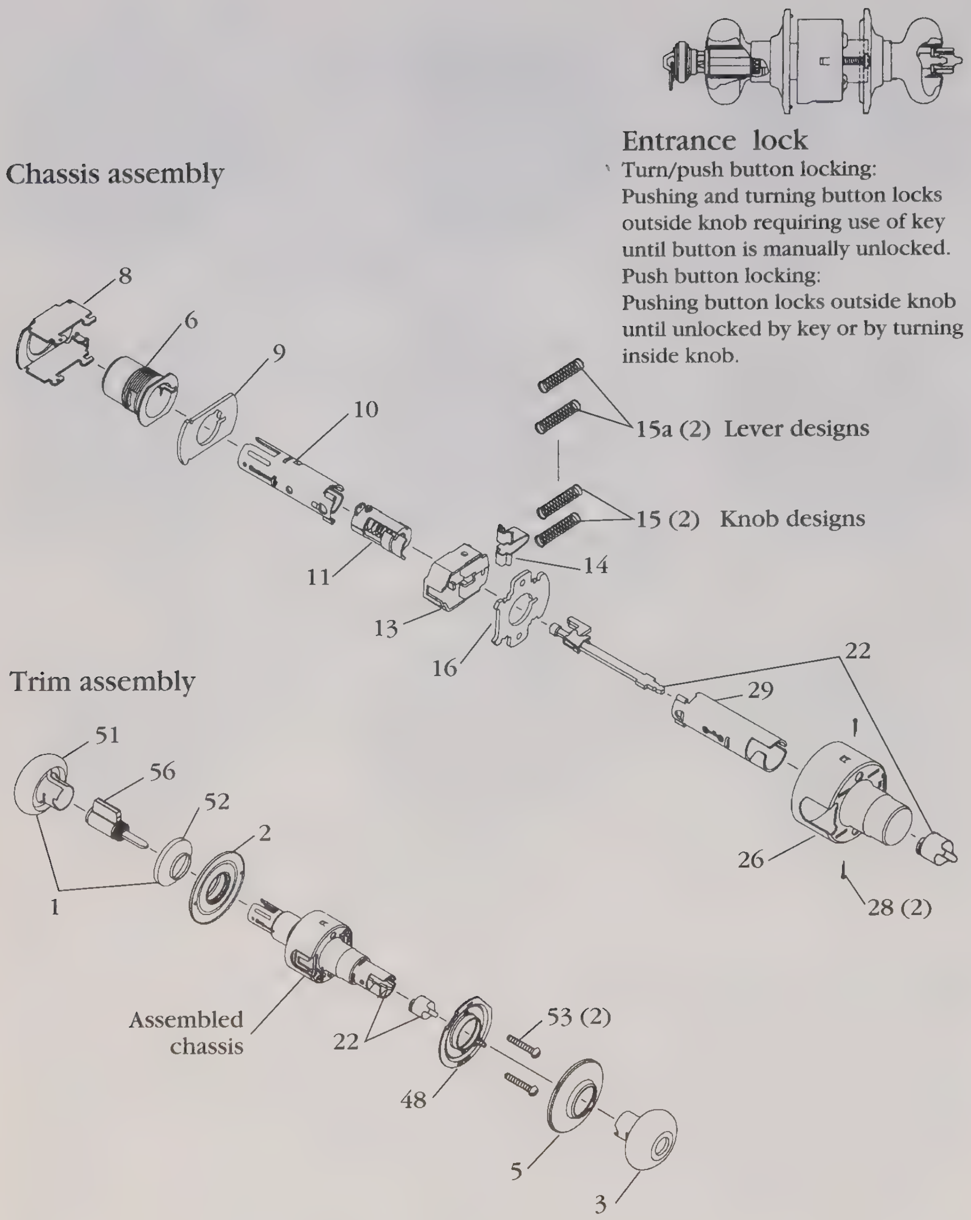
10-14 Schlage's A-Series key-in-knob lock trim assembly. Schlage Lock Co.

hind the shutterguard keeps the internal parts intact and prevents the lock from being forced open from the outside of the door with a screwdriver (Fig. 10-22). The vertical deadbolt slips down into an angled or flat striker plate, which is installed and lined up on the door jamb directly opposite the lock.

Figure 10-23 shows the shutterguard in the closed position. If the cylinder had been ripped out, it would be difficult to slide the shutterguard over. Figure 10-24 shows the shutterguard slid in, allowing the cylinder tailpiece to enter the cam on the inside portion of the cover.

Rim locks come in different designs and can be used without cylinders, making access to the lock from outside a door impossible. Night latch rim locks, rim deadlocks, and automatic slamlock models are also available.

Cylinder guardplates, like the ones shown in Fig. 10-25, are usually installed over rim lock cylinders. These plates supply additional security from cylinder wrenching, drilling, or cutting. Figure 10-26 shows a high-security rim lock cylinder.



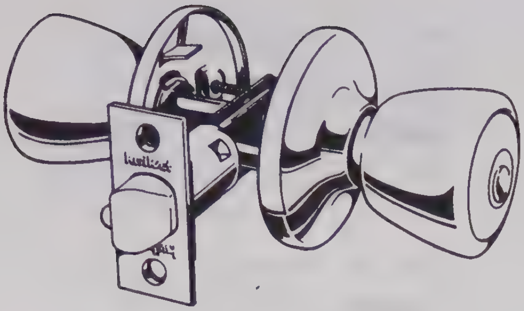
Entrance lock

Turn/push button locking:
Pushing and turning button locks outside knob requiring use of key until button is manually unlocked.
Push button locking:
Pushing button locks outside knob until unlocked by key or by turning inside knob.

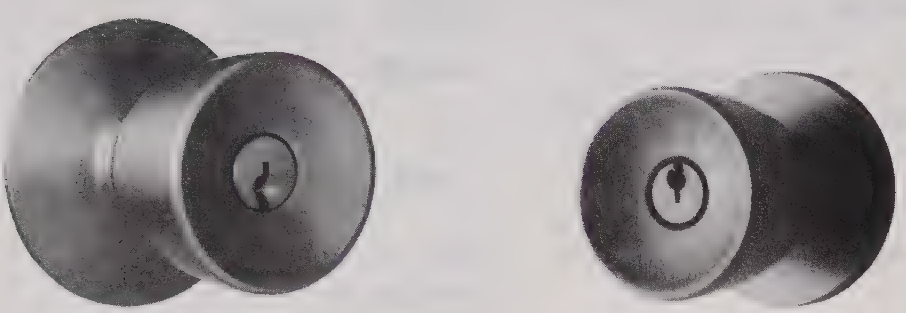
10-15 Exploded view of Schlage's A-Series complete chassis and trim assembly. Schlage Lock Co.

TUBULAR DEADBOLTS

Tubular deadbolts, one of the most common locks, supply additional security at a modest cost, including protection from forced door and jamb separation. If installed properly, these locks can be extremely difficult to defeat. Tubular deadbolts are manufactured with single or double cylinders and come supplied for light, medium-



10-16
Kwikset key-in-knob. Accredited Lock Supply Co.



10-17 The example on the left shows proper cylinder mounting for key-in-knob locks. The example on the right is mounted incorrectly. Schlage Lock Co.

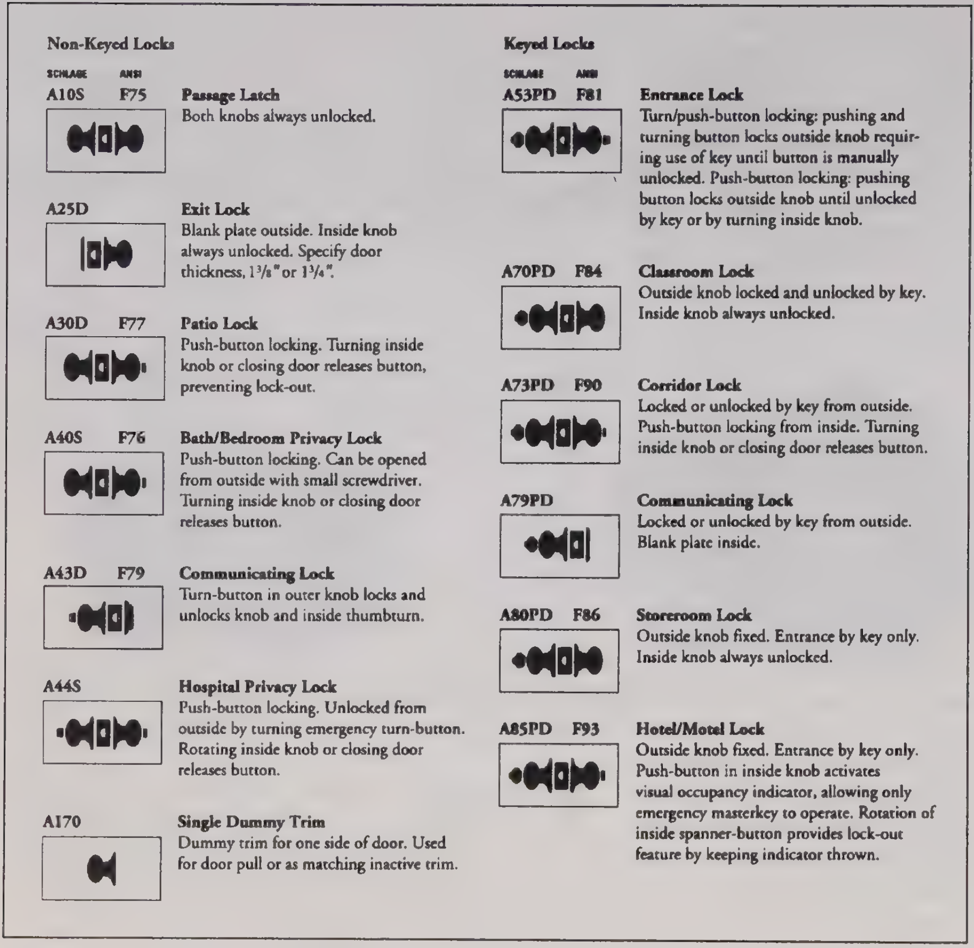
to-heavy-duty, and extra-heavy-duty applications. Tubular deadbolts are installed much the same way as key-in-knob locks. They are cylindrically bored into the facing of the door, although their most secure and common applications are in solid-filled gypsum or wooden doors. Hollow metal doors should not contain deadbolts unless specifically prepared beforehand with hollow-core deadbolt reinforcers.

Basic construction and operation

Good deadbolts incorporate specially manufactured parts that are highly resistant to burglary attempts. As shown in Fig. 10-27, a 1-inch throw deadbolt with hardened steel roller inserts resists sawing or cutting attempts. Also, a free-revolving reinforced deadbolt trim ring makes it difficult for the front assembly to be wrenched off the door by a pipe wrench attack. Additional measures include wooden frame reinforced strike plates with extra long installation screws that screw into the first structure stud that lies alongside the jamb. This prevents kick-in attacks from splitting the door jamb where it is anchored to the strike plate.

Note: It is not recommended that any double-cylinder lock be installed on any door that is used for egress because they constitute a fire hazard. Installations in such situations should be done according to existing codes only (Figs. 10-28 and 10-29).

Deadbolts operate differently from other locks that incorporate spring latchbolts. Once the deadbolt is thrown, the bolt itself becomes locked in position, which prevents any shimming attempts. Most good deadbolts have at least a 1-inch throw from the edge of the door to the end of the protruding bolt.



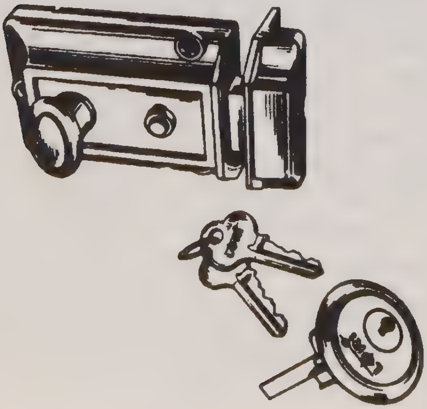
Non-Keyed Locks

SCHLAGE	ANSI		
A10S	F75	**Passage Latch**	Both knobs always unlocked.
A25D		**Exit Lock**	Blank plate outside. Inside knob always unlocked. Specify door thickness, $1\frac{3}{8}$" or $1\frac{3}{4}$".
A30D	F77	**Patio Lock**	Push-button locking. Turning inside knob or closing door releases button, preventing lock-out.
A40S	F76	**Bath/Bedroom Privacy Lock**	Push-button locking. Can be opened from outside with small screwdriver. Turning inside knob or closing door releases button.
A43D	F79	**Communicating Lock**	Turn-button in outer knob locks and unlocks knob and inside thumbturn.
A44S		**Hospital Privacy Lock**	Push-button locking. Unlocked from outside by turning emergency turn-button. Rotating inside knob or closing door releases button.
A170		**Single Dummy Trim**	Dummy trim for one side of door. Used for door pull or as matching inactive trim.

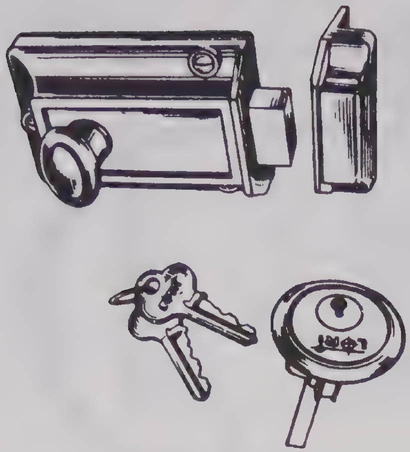
Keyed Locks

SCHLAGE	ANSI		
A53PD	F81	**Entrance Lock**	Turn/push-button locking: pushing and turning button locks outside knob requiring use of key until button is manually unlocked. Push-button locking: pushing button locks outside knob until unlocked by key or by turning inside knob.
A70PD	F84	**Classroom Lock**	Outside knob locked and unlocked by key. Inside knob always unlocked.
A73PD	F90	**Corridor Lock**	Locked or unlocked by key from outside. Push-button locking from inside. Turning inside knob or closing door releases button.
A79PD		**Communicating Lock**	Locked or unlocked by key from outside. Blank plate inside.
A80PD	F86	**Storeroom Lock**	Outside knob fixed. Entrance by key only. Inside knob always unlocked.
A85PD	F93	**Hotel/Motel Lock**	Outside knob fixed. Entrance by key only. Push-button in inside knob activates visual occupancy indicator, allowing only emergency masterkey to operate. Rotation of inside spanner-button provides lock-out feature by keeping indicator thrown.

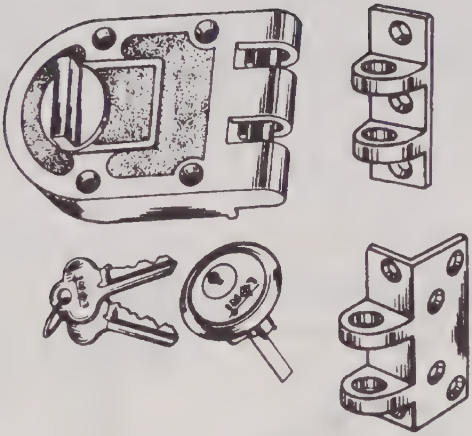
10-18 Shows the most common functions of key-in-knob locks. Schlage Lock Co.



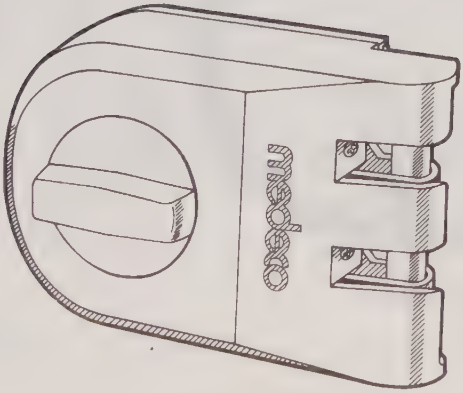
10-19a
A single cylinder rim spring latch.
Accredited Lock Co.



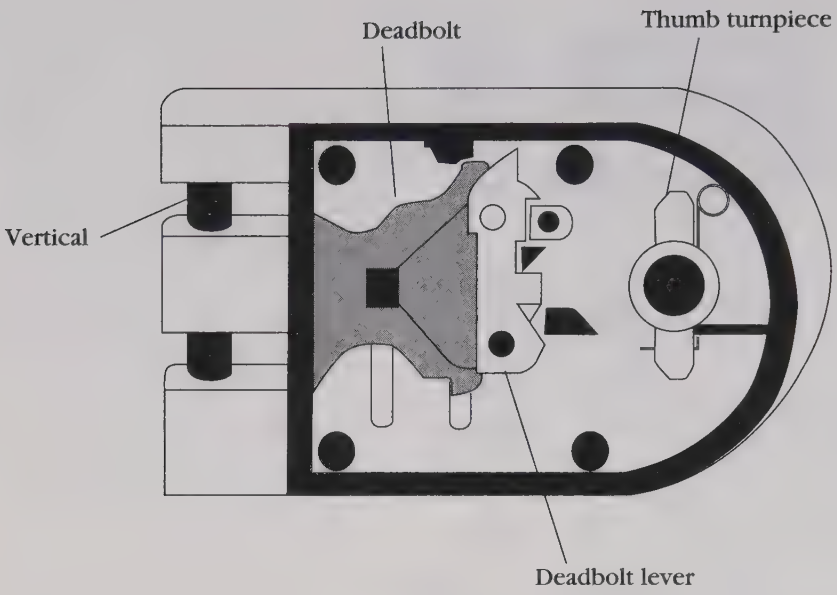
10-19b
A single cylinder deadlock. Accredited Lock Co.



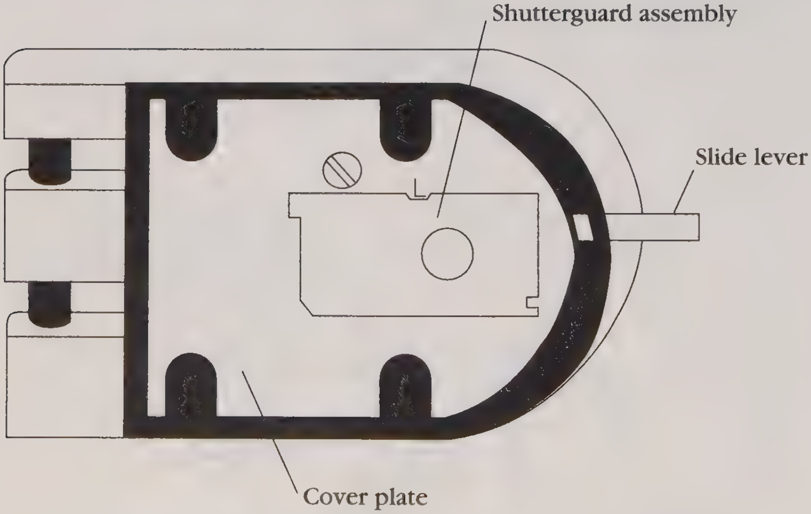
10-19c
A jimmy-proof vertical deadbolt. Accredited Lock Co.



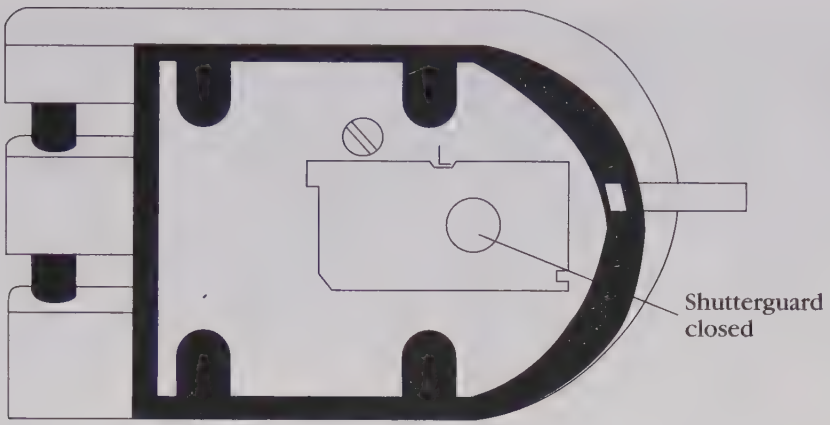
10-20
Medeco's Steelguard vertical deadbolt. Medeco High Security Locks



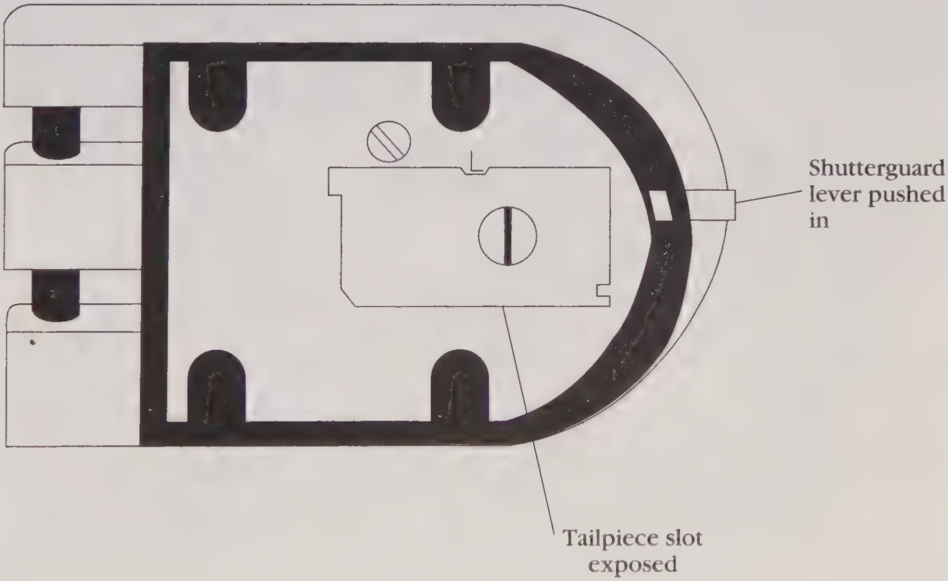
10-21 Shows the inside parts of a typical vertical (rim) deadbolt lock.



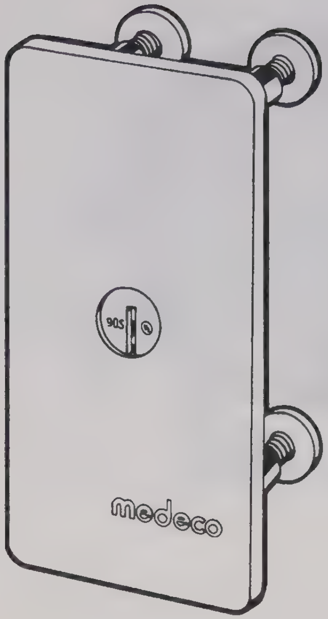
10-22 Shutterguard assembly and cover plate.



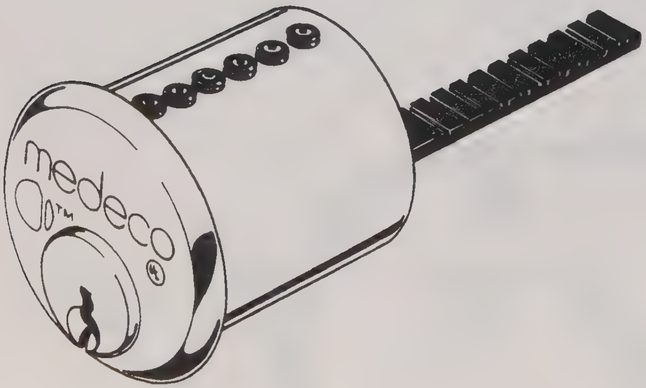
10-23 Shows shutterguard closed.



10-24 Shows shutterguard open.



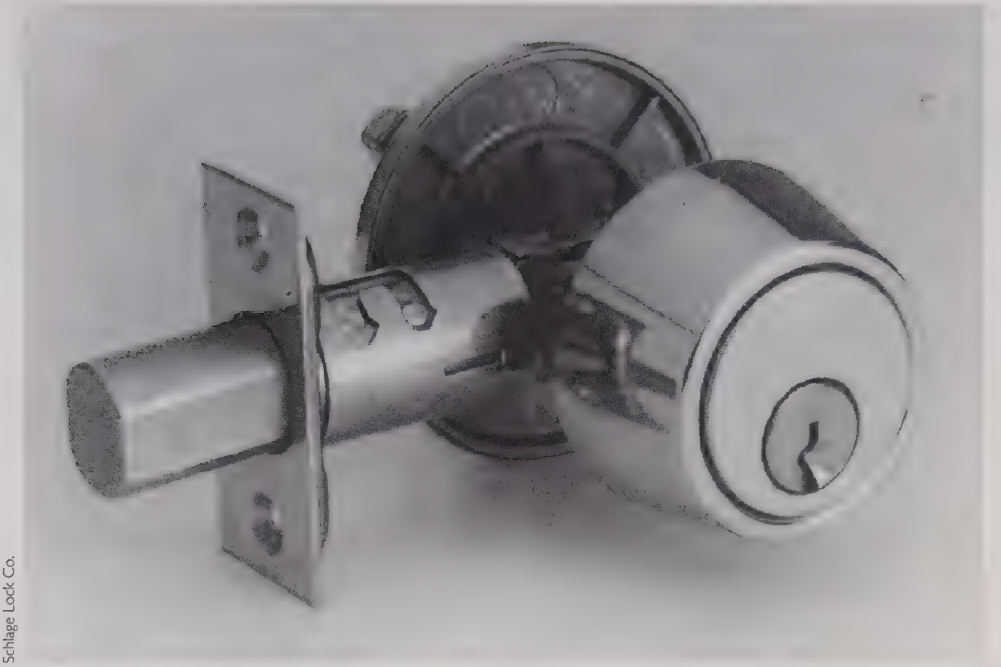
10-25
Medeco's Bodyguard armored cylinder plate. Medeco High Security Locks



10-26
A Medeco rim cylinder. Medeco High Security Locks

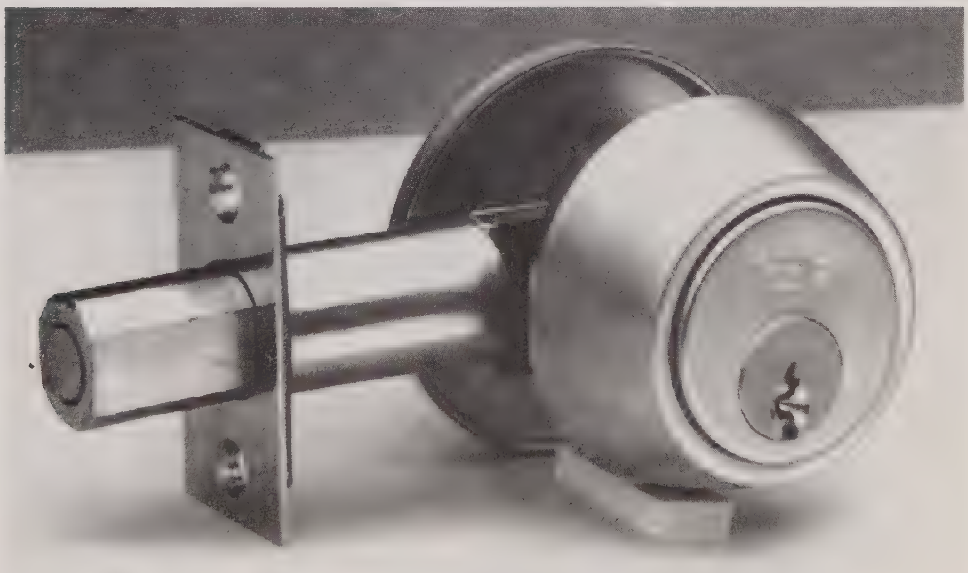
PADLOCKS

Padlocks are impervious to the most conventional and advanced forms of vandalism and attack and offer the ultimate in weather-resistant design. Most come with removable cylinders that allow for quick and easy rekeying and enable them to be rekeyed to fit door locks. Others come with combination mechanisms for key-free locking and unlocking. Padlocks today have a wider range of use than ever before. Besides protecting bikes, cellar doors, vending machines, and tool boxes, they can be seen on the backs of van doors, on utility company equipment, gates, on railroad switching boxes, lockers, doors, and everywhere else their unique design can be utilized with or without a strong steel hasp. There are dozens of standard designs and



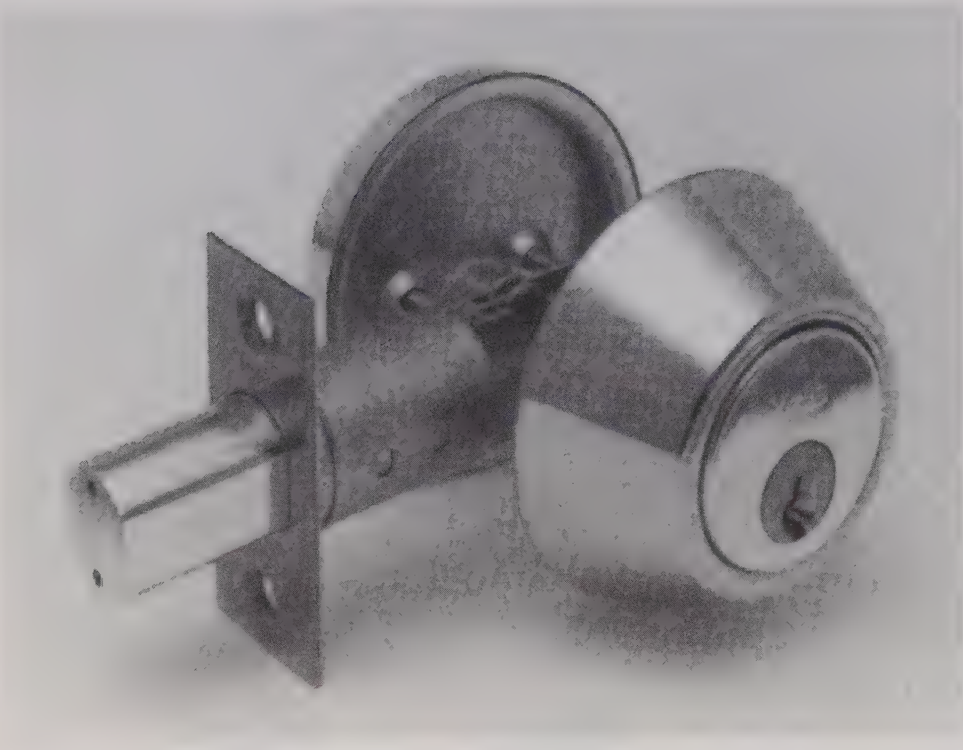
Schlage Lock Co.

10-27 Schlage deadbolt.



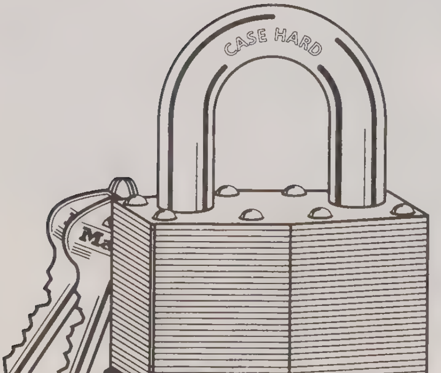
Yale Security Inc.

10-28 A Yale security deadbolt with hardened pin.

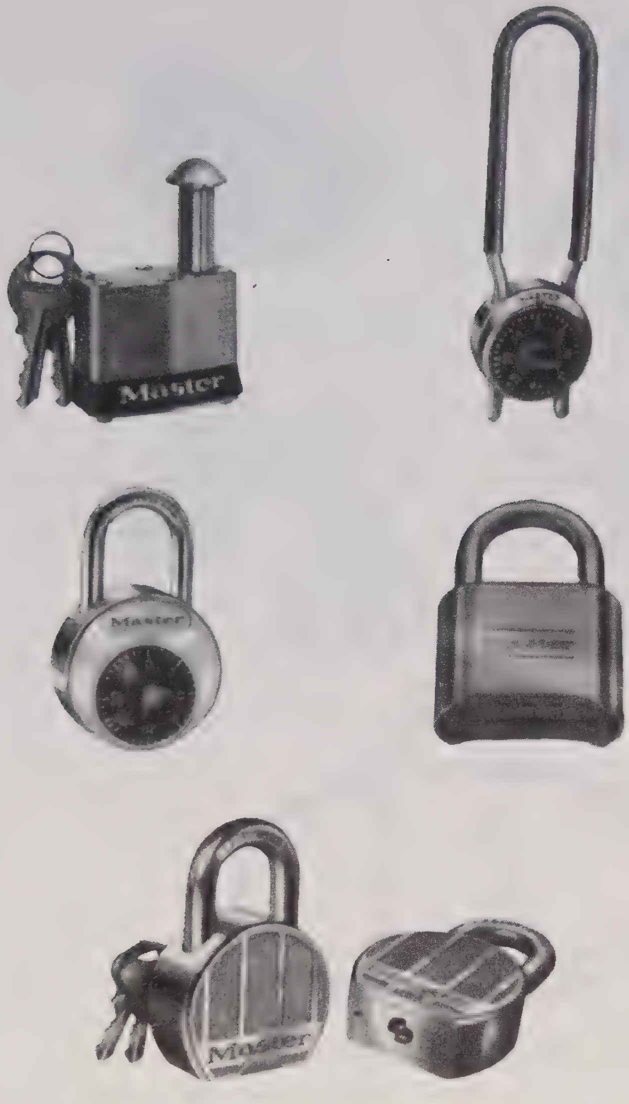


Yale Security Inc.

10-29 A Yale 3000 residential deadbolt.



10-30
A High Security padlock. Master Lock Co.



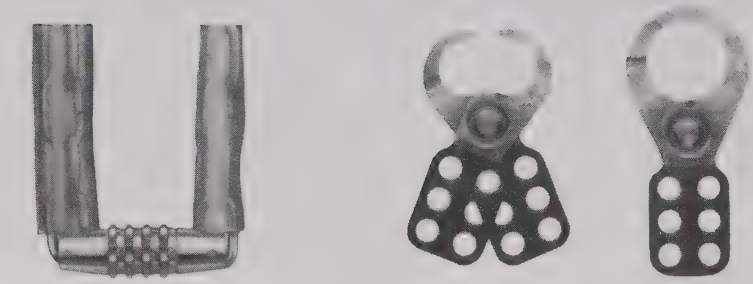
10-31
Common keyed and combination padlocks sold today. Master Lock Co.

special application models that make specific padlocks particularly suitable for specific applications (Fig. 10-30).

Figure 10-31 shows a few of the most commonly bought keyed padlocks and combination padlocks. Figures 10-32 and 10-33 show other common types of locks manufactured by The Master Lock Co. for other applications.

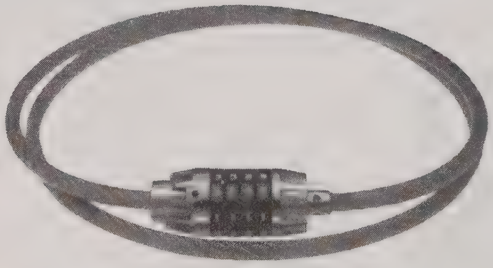
Trailer lock

Gun lock



Barrel combination lock

Safety lockout

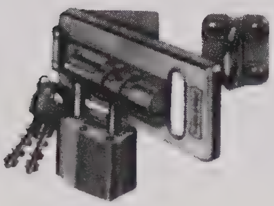


Resettable combination cable lock

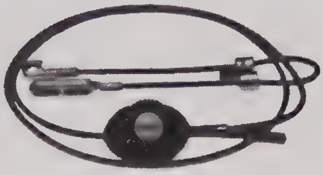
10-32 Special application products manufactured by Master Lock Co. Master Lock Co.

General security cables

Identification tags
and mounting collars



General security hasplock



Combination
ski lock

Industrial U-bar locks

10-33 Master Lock Co. products. Master Lock Co.

11

High-security locks, keys, and cylinders

When the term *high security* is used to describe locks, keys, and cylinders, most locksmith professionals, manufacturers, and salespeople spend time debating over the actual definition of what constitutes high security. One product might be considered high security because it has a pin tumbler cylinder that is extremely difficult to pick, another product might be considered high security because it resists physical tampering or attack, and yet another might be considered high security because there might be only one locksmith in a 150-mile radius authorized by the product's manufacturer to sell, service, and install the product and the keys that operate it.

Debate has arisen during the past two decades of what a fair and reasonable definition is of a high-security lock. At present, the only widely recognized and accepted standard that attests that a lock cylinder provides a high degree of security is United Laboratory's listing UL437 for lock cylinders. This listing determines whether or not picking or drilling is a practical approach to compromise the cylinder. It does not, however, address the duplication or manufacturing rights of the key blanks for those cylinders. Most industry professionals, however, will probably agree that a high-security product should offer the following:

- high resistance to lock picking
- high resistance to drilling or wrenching
- carefully planned and enforced key sales and duplication control
- protection of operational design and keying patents

CHOOSING A HIGH-SECURITY CYLINDER

When you, as a locksmith, decide to sell high-security locks, you should weigh quite a few variables before you decide which product you will offer your customers. There are literally dozens and dozens of high-security locks and cylinders on the market today, and many more coming. Consider the following factors suggested by the ASSA High Security Lock Company before you decide which product you will sell.

Quality

Inspect the product's construction. Cutaway cylinders are good for this purpose. Would you be proud to sell the product? Do you notice any design flaws in the product that you suspect might hinder its resistance to forced entry?

Security
Is the product a true high-security cylinder? Is it both pick and drill resistant? The most common qualifier is the UL437 listing for lock cylinders.

Patents
What patents, if any, have been issued to protect the security of the products? What exactly do the patents cover? When do these patents expire? It is generally agreed that key-blank patents are more valuable than cylinder patents. If you have any doubt, ask to receive a copy of the patent(s).

Key control
If your customers are interested in key control, what do you have to sell them? How good is the key control you have to offer? What assurances can you make about the availability of duplicate keys?

Product flexibility
Is the product design flexible? How many different cylinders will you need to stock? Can some products be used for more than one application?

Simplicity
Simple function often indicates reliability. Evaluate the operation of the cylinder. Ask other locksmiths who have used the product. Are they aware of any special problems?

Product assortment
Does the manufacturer offer a wide range of products to retrofit most types of hardware? Are there any common applications that you will be unable to retrofit with this product?

Keyway restriction
Does the program offer a keyway that is restricted to your company? If so, how extensive is the restriction? What other locksmiths, distributors, end users, etc., are able to use that keyway? Where are they located?

Key machines
Is a special machine required to cut the keys? If so, what is the cost of this equipment? Can it be used for another purpose?

Initial investment
What is the total initial investment required to become a dealer? How much of this investment is in saleable merchandise, instead of special machines, fixtures, etc.?

Annual investment
Is there a minimum annual purchase volume requirement? If so, are you confident you can reach this level each year?

Serviceability
How easy is the product to service? How long will it take to rekey a cylinder or to cut a duplicate key? Can it be done easily in the field, or must you bring it back to the shop?

Marketing assistance

Is the manufacturer able to provide product literature, artwork for advertisements, or cooperative advertising programs?

Technical training

How much technical training will be required for you and your staff? Will it be easy to train new employees? Does the manufacturer offer hands-on certification classes, or other instructional aids such as service manuals, videotapes, etc.?

Availability

Are you confident that the product will be available when you need it? Is it in stock at your distributor? Do you know if the manufacturer's lead times are reasonable?

Master keying

How extensive are the product's master keying capabilities? Is the product difficult to master key? Will the factory assist you in the design of systems?

Salability

Think of your customers. Will they want to buy this product? Does it suggest security? Is it easy to use?

Price

Is the product competitively priced with similar brands? Compare list prices and take into account all items, including pin kits, key blanks, etc.

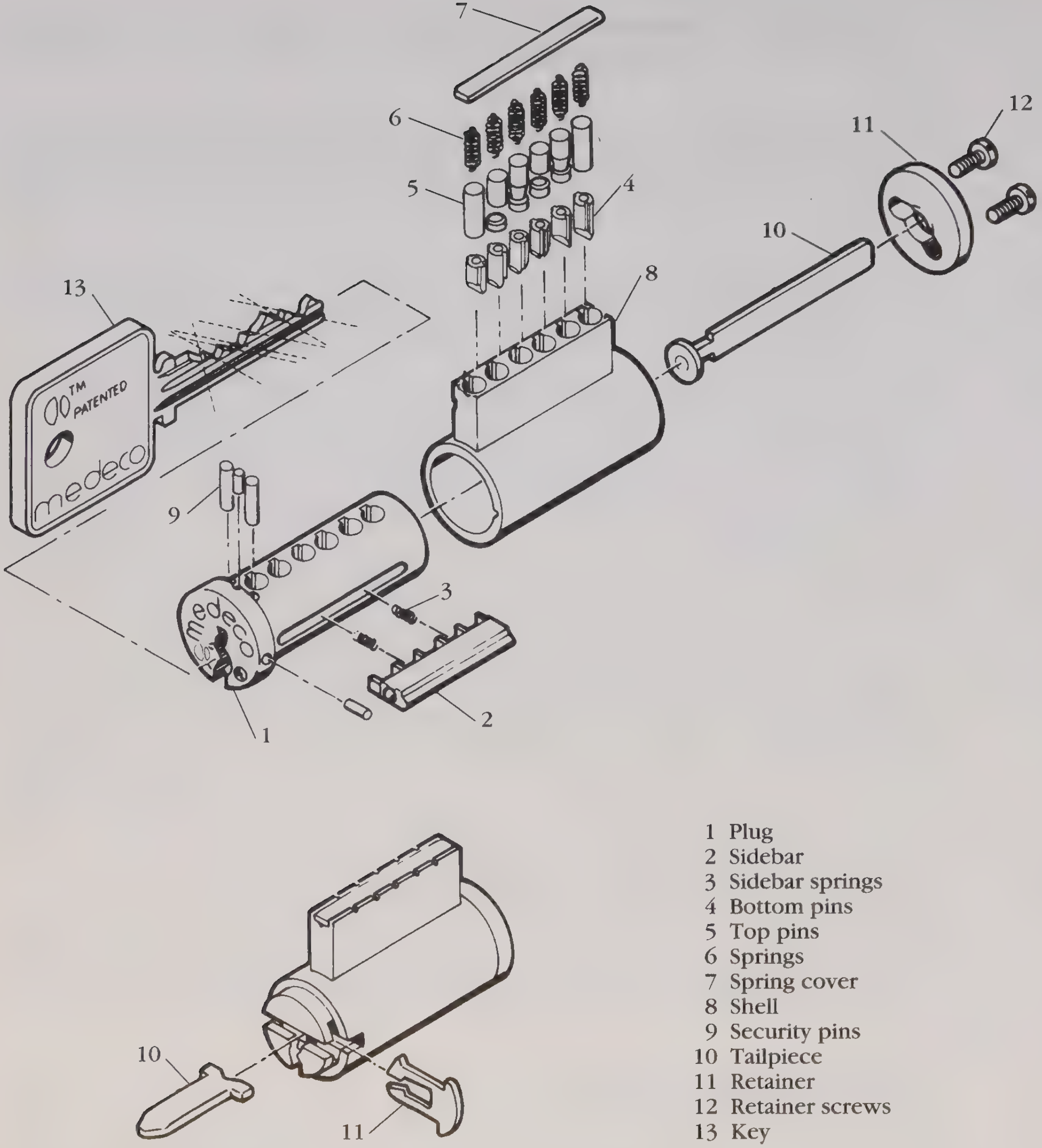
The rest of this chapter will introduce you to the cylinders, products, and operational procedures of three of the leading high-security lock manufacturers in North America. These products were chosen because of the high standards, availability, and serviceability their products possess for the professional locksmith and end user.

MEDECO HIGH-SECURITY LOCKS

Medeco high-security locks have been at the forefront of high-security locking mechanisms since the 1960s. It was then that the first Medeco high-security lock was invented and patented. This unique design has become one of the most important advancements in locking mechanisms for more than a century.

The Medeco locking principle

Medeco high-security cylinders use a combination of standard pinning principles: *elevation* with the addition of a unique sidebar assembly, which acts as a second obstacle to prevent lock picking *rotation* (Fig. 11-1). In effect, each pin tumbler inside a Medeco cylinder must simultaneously be lifted to the proper height at the shearline (within exacting tolerances) and also rotated into the proper position to allow the sidebar to be retracted into the plug. This gives Medeco cylinders an extra level of high security, which supplies a dual-locking principle. In addition, the placement of hardened, drill resistant inserts in key places in the lock cylinder makes it extremely difficult to drill the cylinder's shearline and sidebar.



1 Plug
2 Sidebar
3 Sidebar springs
4 Bottom pins
5 Top pins
6 Springs
7 Spring cover
8 Shell
9 Security pins
10 Tailpiece
11 Retainer
12 Retainer screws
13 Key

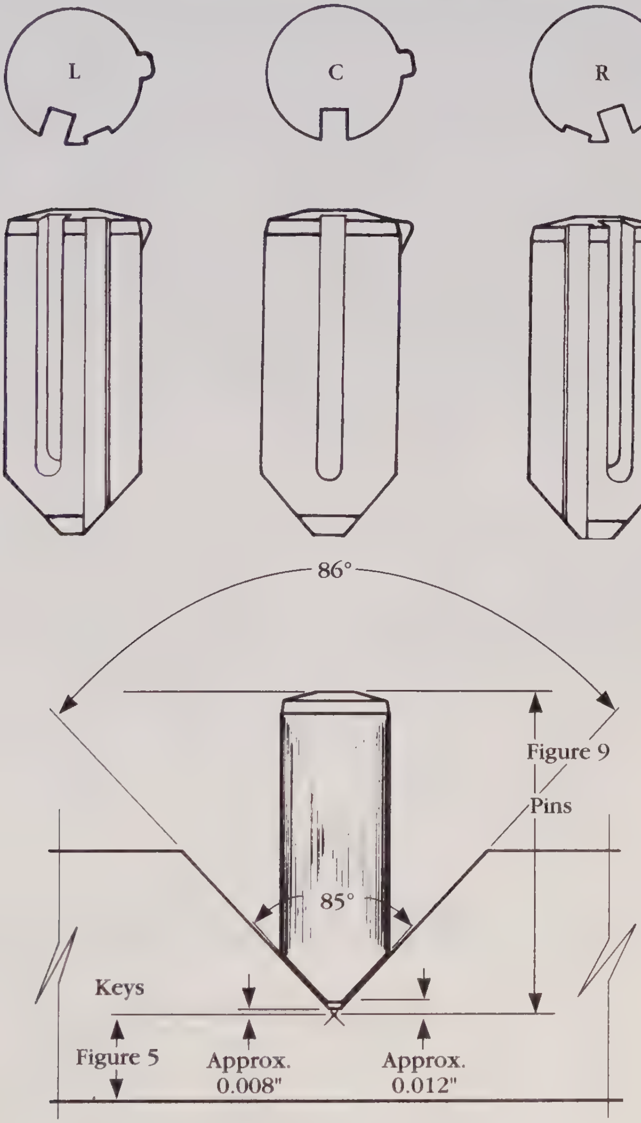
11-1 Exploded parts view of a Medeco key-in-knob high security cylinder. Medeco High Security Locks

But that's not all. Also incorporated into the Medeco locking principle is the specially cut key. A standard Medeco key must be cut with a combination of up to three different angles. It is these angles on the key cuts that properly lift and place each pin tumbler at the exact right height and proper position for the sidebar.

Presently, there are two main types of Medeco keys and pinning arrangements: the standard Medeco keying arrangement and the expanded Medeco biaxial cylinder and key design. The main difference between the standard Medeco cylinder and the new biaxial design is the chisel point location of each bottom pin tumbler and the dimensional spacing of each cut on the key.

Standard construction

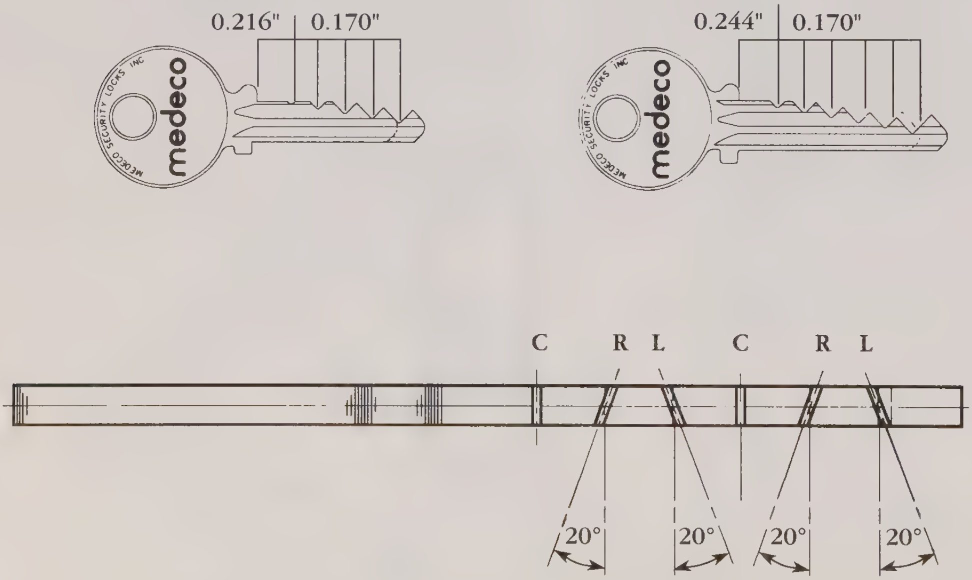
In the standard Medeco pin design each bottom pin, of which there are six basic sizes, are bottom-chisel pointed at an 85-degree angle (Fig. 11-2). It is the sides



11-2 Medeco bottom pins and pin angle. Medeco High Security Locks of these pin angles that must align and seat properly into the sides of the cut profile on one of the three Medeco key angles on each key. Unlike standard cylinder pins, the bottoms of the Medeco pins do not make contact with the flat bottom of each key cut. In addition, each standard Medeco pin has a groove milled out (sidebar slot) almost all the way down to the bottom of the pin. This groove is for accepting the sidebar legs once each pin is rotated to the proper position (facing directly at the sidebar). These slots are milled out at either the left, right, or center portion, which is in relation to the axis of the chisel point. On each standard pin is a minute swedged projection, or *locator tab*, at the top end of each pin. This locator tab sits into a broaching in the cylinder shell and acts as a rotational guide and stop, which prevents each pin from rotating a full 180 degrees.

Standard Medeco top pins come in six basic top lengths and finish off a matched set to the bottom pins. A #1 bottom pin matches a #1 top pin, and so forth. Each combination of bottom and top pins must equal a constant stack height of .515 of an inch, which allows for proper spring steel pressure. Top pins also contain two mushroom driver pins that can be used.

Each standard Medeco key has four dimensional specifications: the cut profile, the cut spacing, the cut depth, and the cut angular rotation. There are six basic depths that correspond to the six main bottom pin sizes. Each angular cut maintains an 86-degree angle. There are three angles: left, right, and center. A bottom pin in the first chamber with a left-milled sidebar slot must have a left-angular cut put into the key in the first spacing position. All the other cuts must also correspond to the specific angle coding of each key, as well as the proper cut depth (Fig. 11-3).



11-3 The Medeco key showing center, right, and left cut angles. Medeco High Security Locks

Basic operation

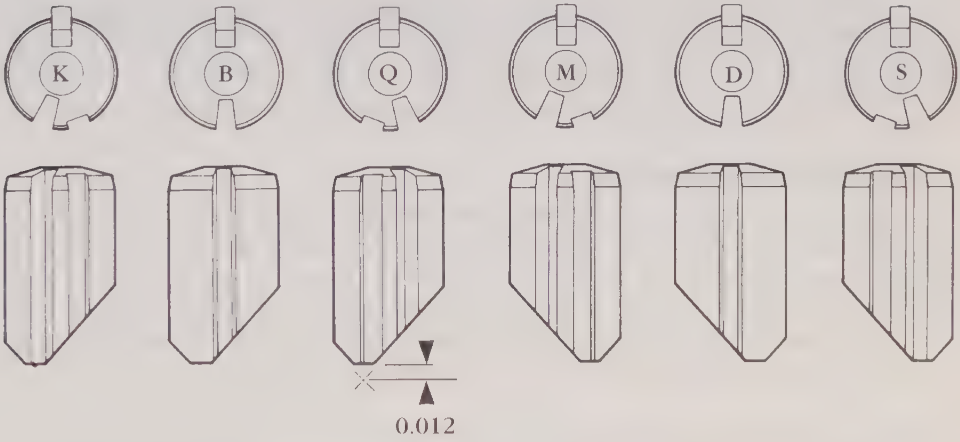
When each bottom pin is properly raised to the shearline and rotated to create an unblocked shearline, the legs of the sidebar will enter into the sidebar slots of each bottom pin and allow the sidebar to enter all the way into the plug. This allows the plug to be rotated.

BIAXIAL OPERATION AND CONSTRUCTION

In the new biaxial design, the locking principle is basically the same as that for standard Medeco cylinders. The proper elevation and rotational placement of the pins creates a proper shearline and allows the sidebar to enter into the plug. The big difference, however, is the construction of the pins, the stack height, the number of top pins, and the angular cuts on the key. These differences make for greater pick resistance and for a greater number of keying possibilities.

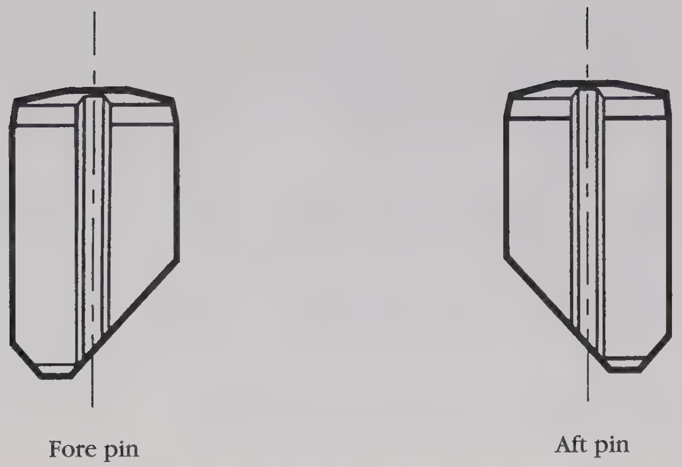
Biaxial pin construction

Biaxial pins differ from original Medeco pins in three respects: the chisel point, the locator tab, and the pin length (Fig. 11-4). Biaxial pins are made of CDA340 hard brass and are electroless-nickel plated. They have a diameter of .135 inch and are chisel pointed with an 85-degree angle. The chisel point is offset 0.031 of an inch in front of or to the rear of the true axis or centerline of the pin. These pins are referred to as either *fore* or *aft* pins (Fig. 11-5).



11-4 Biaxial bottom pins. Medeco High Security Locks

Fore pins are available in three different angles: B, K, and Q. Aft pins are also available in three angles: D, M, and S. Pins B and D have a sidebar slot milled directly above the true centerline of the pins. Pins K and M have their slots milled 20 degrees to the left of the true centerline of the pin, and pins Q and S have their slots milled 20 degrees to the right of the true centerline of the pin.



11-5 Medeco biaxial fore and aft pins. Medeco High Security Locks

The locator tab has been moved to the side of the pin at roughly a 90-degree angle. It is now located along the centerline of the pin, opposite the area for the sidebar slot.

There are six bottom biaxial pin sizes, but only five top pin sizes, with top pin #3 being used for both the #3 and the #4 bottom pins. The #3 top pin is a mushroom-shaped pin.

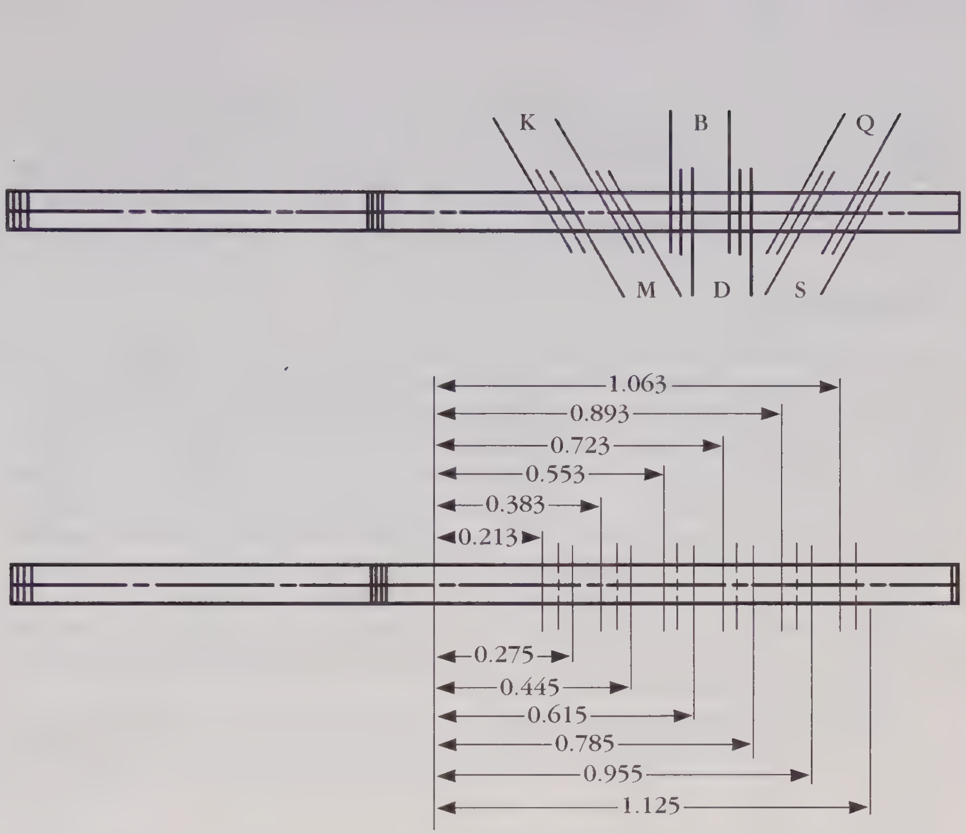
Unlike the standard Medeco pinning arrangement, the biaxial pinning arrangement does not require a constant stack height. It does require, however, that the stack height maintain a minimum of .499 inch, and a maximum of .524 inch to maintain proper spring pressure.

Biaxial keying specifications

The main difference between the standard Medeco key and the biaxial key is the spacing from the shoulder of the key blade to the center of the cut (Fig. 11-6). Depending on whether an aft or fore pin is used, the center of the cut will be either closer to the shoulder or further from it. From the shoulder to the center of the first cut using a fore pin (B, K, or Q), the dimension would be .213 inch; using an aft pin (D, M, or S) the dimension would be .275 inch.

Maximum adjacent cut specifications

Maximum adjacent cut specifications (MACS), in standard pinning as well as in high-security pinning, refers to the allowable depth differential between adjacent cuts on a key and pins in a chamber. For instance, on standard Medeco keys the allowable MACS specification states that a #1 cut cannot be adjacent to a #6 cut and vice versa. No cuts greater than .120 inch adjacent to one another are allowed. This is because a #6 cut would cancel out a #1 cut. (In other manufacturers' pinning rules, the MACS might vary depending on the stepped increment of the pins and how many sizes are available.)



11-6 Medeco biaxial key cut angles and spacing dimensions. Medeco High Security Locks

In Medeco biaxial, the MACS are a bit more complicated due to the fore- and aft-cut spacing.

Biaxial MACS
Aft to Fore-0.050" MACS = 2
Fore to Aft-0.075" MACS = 3
Aft to Aft-0.075" MACS = 3
Fore to Aft-0.100" MACS = 4

MEDECO KEY CONTROL

As stated earlier, key duplication and key distribution control is extremely important to high-security applications. High-security cylinders might easily be compromised if key blanks and key duplication were uncontrolled. Medeco currently has various key-control programs.

Most Medeco keys can be made quickly and without delay by any Medeco locksmith with the Convenience Program. This program is for customers who rely on their Medeco cylinders for the best form of physical protection, but who do not require the added protection of specific key-duplication control. Medeco also has a Card Program. This program supplies each Medeco lock owner with an embossed identification card. To have a key made, the owner must present the card to a participating locksmith, who in turn verifies all the information and then has duplicate keys made by an authorized distributor, usually within 24 hours. Other programs take key duplication and key blank availability away from the locksmith and locksmith distributor and keep it at the Medeco factory, like Medeco's new Patriot Program.

The Patriot program

The Patriot Program is one of the best key-control programs in the locksmith industry today. All record keeping is done by Medeco at the factory so the locksmith doesn't have to fuss with key-control records at the shop level. After an initial investment and training seminar, the Patriot locksmith receives a special card reader and printer that hooks directly to the phone line. When a customer comes in to have a Medeco Patriot key duplicated, the locksmith takes the customer's identification card and slides it through the reader, after punching in the number of keys needed. The reader automatically dials the Medeco factory. After a few seconds the printer prints up a two-part carbonless receipt that shows the tracer number, dealer code, date, time, customer's name, key code, key set identification, and the numbers of keys that can be cut. The customer signs both copies and then keeps one copy. The other is retained by the locksmith.

Medeco Patriot key blanks are inventoried for each dealer by Medeco and are sent automatically to the locksmith, thus eliminating the possibility of the locksmith running out of keys.

ADDITIONAL MEDECO PRODUCTS

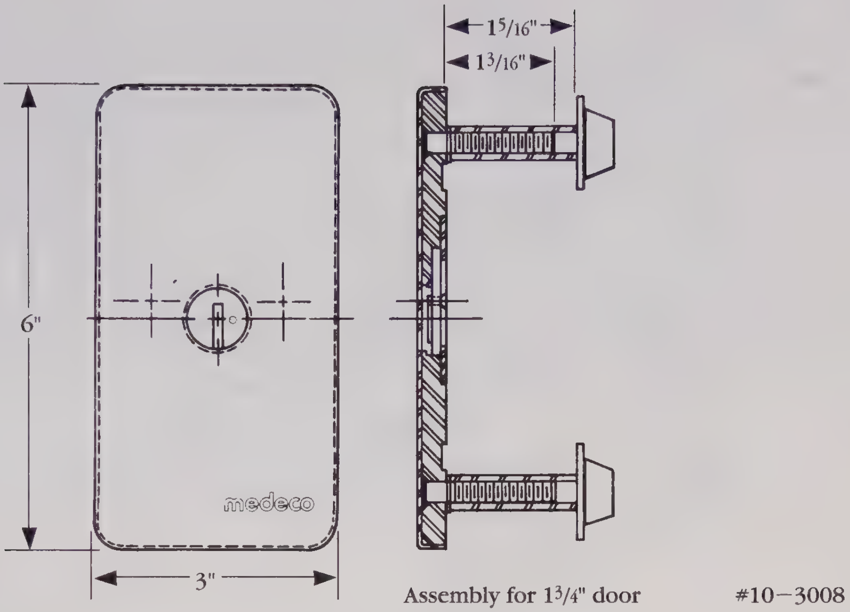
Figure 11-7 shows Medeco's armored bodyguard plate for rim locks, which is the ultimate in rim cylinder protection. The plate itself is constructed of $5/16$ inch of solid steel with mounting bolts that are threaded, welded to the plate, and enclosed by Medeco's exclusive hardguard sleeves. This plate can be used with Medeco products or with any other rim lock.

Figure 11-8 shows Medeco's D-10 high-security dropbolt. This lock offers the best in rim lock protection. Combined with Medeco's bodyguard plate, the dropbolt mounts with a vise-like hold that makes it one of the most difficult locks to penetrate.

Figure 11-9 shows Medeco's MAXUM deadbolt. The MAXUM deadbolt offers superior deadbolt protection and is specifically designed to be convenient for its users. The MAXUM has added features that make it universal, easier to install, and even more resistant to physical attack than previous Medeco deadbolts. The MAXUM provides maximum protection with antidrilling and antiprying features. The MAXUM is recommended as the best door lock for residential, business, and institution use. It comes in eight finishes and its appearance enhances any door.

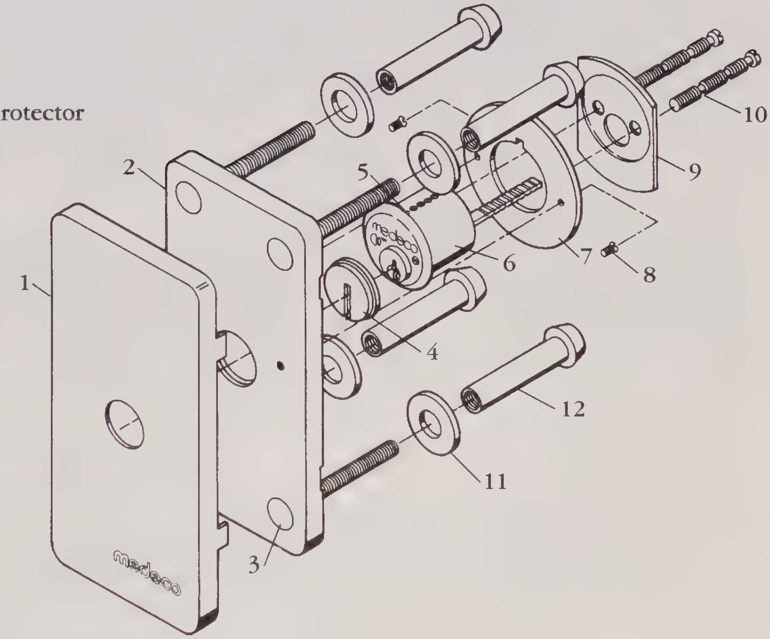
THE ASSA TWIN 6000 HIGH-SECURITY CYLINDER

As shown in Fig. 11-10, the construction of ASSA's Twin 6000 high-security cylinder is much different than that of a standard pin tumbler cylinder. With this construction, ASSA has taken a unique approach to providing for high resistance to picking and drilling while at the same time offering highly effective key-blank and key-duplicat-

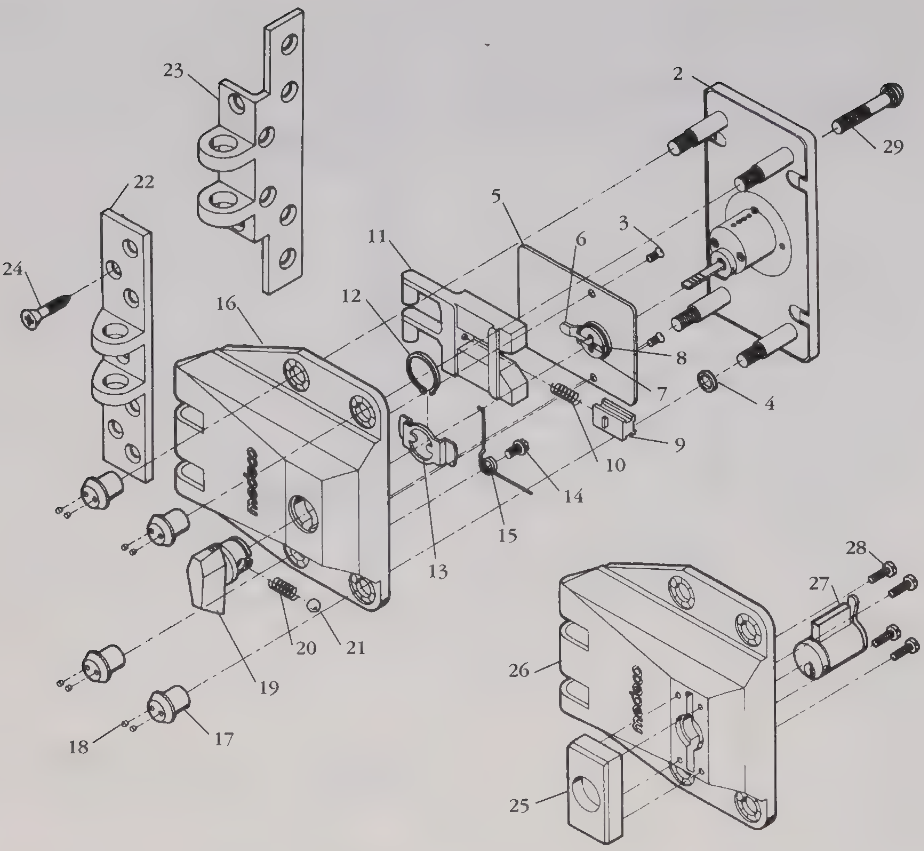


Assembly for $1^3/4$" door #10–3008

1 Cover plate
#CP–180201
2 Security plate assembly
#CP–180221
3 Plow bolt
#CP–281440
4 Hardened cylinder plug protector
#CP–280231
5 Longer set screw
#CP–011013–030
6 Rim cylinder
7 Cylinder retaining plate
#CP–021201
8 Retainer screw
# CP–010107–040
9 Rim cylinder backplate
#CP–180031
10 Rim cylinder mounting
screw
#CP–02917–000
11 Washer
#CP–04111X
12 Hex nut tamper proof
#CP–281421



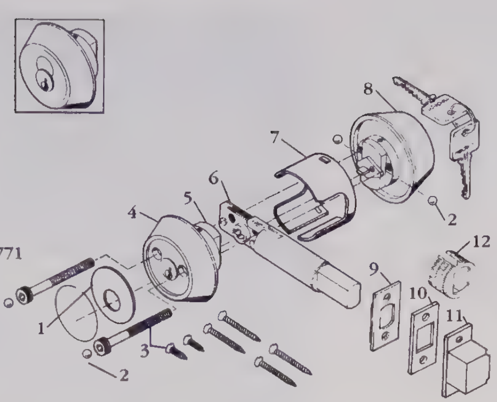
11-7 Exploded view of the Medeco bodyguard plate assembly. Medeco High Security Locks



1 Guard plate assembly CP−180391 discontinued
2 Bodyguard® assembly 10−3004
3 Flat head screws CP−010113−060
4 Spacer washer CP−160150
5 Cover plate CP−180301
6 Cam CT−Z30
7 Cam adaptor CP−130061
8 Retainer CP−020140
9 Lock actuator CP−100201
10 Compression spring CP−030037
11 Locking bolt CP−090171
12 Retainer CP−020130
13 Cam−Thumbturn CT−Z31
14 Hex washer rolok screw CP−012015−060
15 Torsion spring CP−030038
16 Housing−Thumbturn assembly CP−280501
17 Tamper proof hex bolts CP−280561
18 Tamper proof pins CP−060422
19 Thumbturn & thumbturn shaft assembly CP−280551
20 Compression spring CP−030024
21 Ball CP−250070
22 Flat strike CP−280571
23 Angled strike CP−280541
24 Wood screws
  #10 2" CP−010237−20
    3/4" CP−010238−120
    3/4" Typ AB CP−010139−120
25 Cylinder housing 4 pin CP−280521 5 pin CP−280531
26 Housing−double cylinder assembly CP−280511
27 Cylinder 4 pin 20−6051 5 pin 20−6052
28 Pan head screws CP−010413−120
29 Tamper proof mounting bolts CP−280601

11-8 Exploded view of Medeco's D-10 high-security dropbolt. Medeco High Security Locks

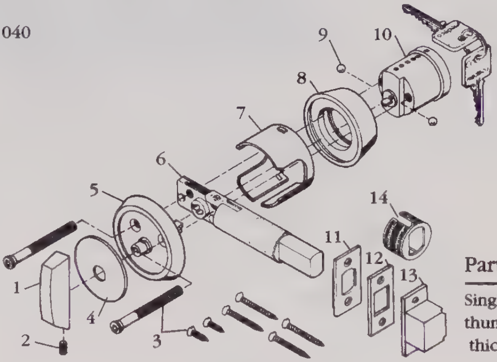
1 Trim plate package for double cylinder #94–0029
2 Ball #CP–250020
3 Screw package #CP–D11702
4 Security collar #CP–070371
5 Inside cylinder assembly #11–0097
6 Bolt assembly 2 3/8 B.S. #11–0030
2 3/4 B.S. #11–0040
7 Shield #CP–260070
8 Security collar #CP–070371
9 Rectangular front assembly #CP–180771
10 Strike plate #CP–180061
11 Strike reinforcement #CP–280620
12 Circular front package #94–0026



No. 11–0102

Double cylinder

1 Thumbturn CP–281501
2 # 8–32 × 1/4 Set screw CP–012413–040
3 Screw package CP–011713
4 Thumbturn cover CP–180861
5 Thumbturn base assembly 11–0094
6 Bolt 11–0030 or 11–0040
7 Security sleeve CP–260070
8 Collar CP–070341
9 Balls CP–250020
10 Outside cylinder assembly 11–0098
11 Face plate CP–180771
12 Strike CP–180061
13 Strike reinforcement CP–280620
14 Drive in assembly 94–0026



Part No. 11–0100

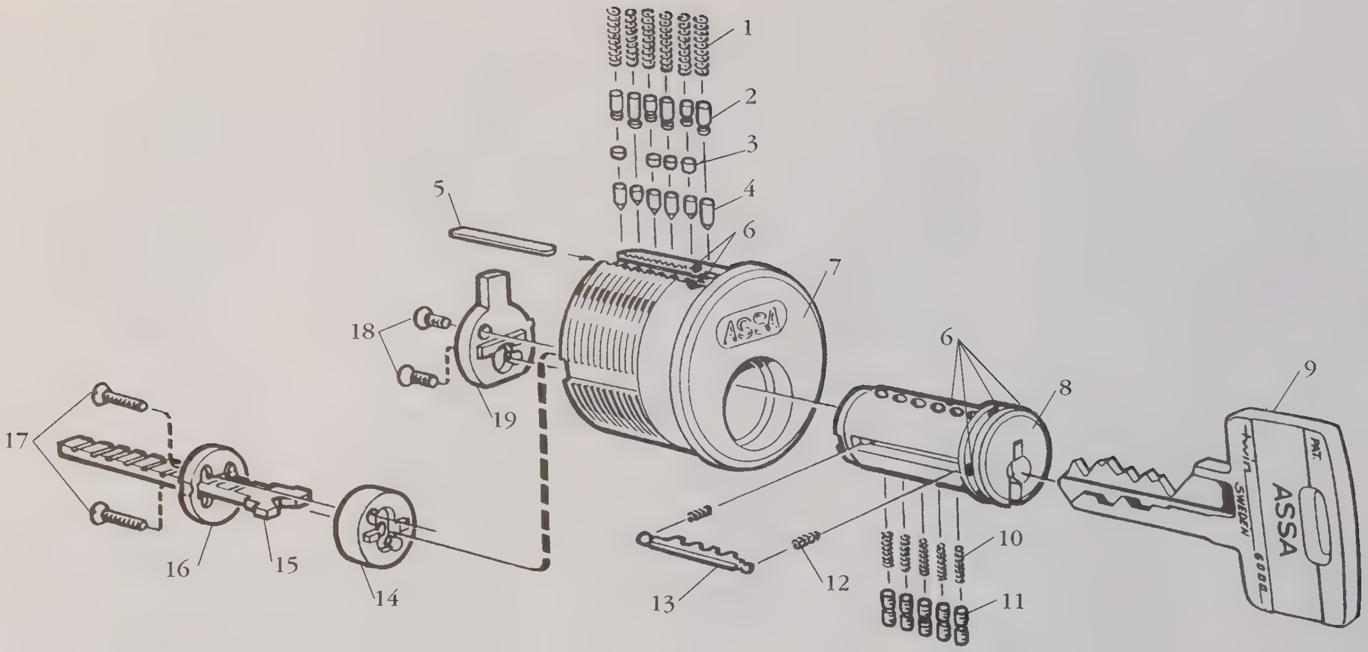
Single cylinder with thumbturn for 1 3/4" thick door

11-9 Exploded view of Medeco's D-10 MAXUM deadbolt. Medeco High Security Locks

ing control. One of the most interesting conveniences, however, is the attractive investment program designed for professional locksmiths. You don't need a fancy, expensive key machine or other equipment to become involved with this product. The special ASSA key, which comes precut for a sidebar code, can be code-cut by any key coding machine or duplicated by any duplicator using special depth keys that are provided only by ASSA.

Basic operation and construction

The most unique components of the ASSA high-security cylinder are the coded sidebar and the ASSA key. One glimpse at the key, shown in Fig. 11-11, reveals the addition of a second key-bitting arrangement on the side of the key blank. All ASSA key blanks come equipped with a uniquely coded sidebar bitting, which makes it possible to have almost 3,000 different sidebar codes. This allows all ASSA cylinders and ASSA key blanks to operate under one keyway profile, which is virtually unheard of in high-security applications. Each unique sidebar code supplies restricted keying. So powerful and effective is this coded sidebar design that an improperly coded ASSA key blank that is put into an ASSA cylinder will not turn. The sidebar itself will lock the plug.



1 Springs
2 Drivers
3 Master pins
4 Bottom pins
5 Cover strip
6 Drill resistant pins (in place)
7 Cylinder housing
8 Cylinder plug
9 Key with sidebar code
10 Sidepin springs
11 Sidepins
12 Sidebar springs
13 Sidebar
14 Rim tailpiece adapter
15 Rim cylinder tailpiece
16 Rim tailpiece washer
17 Rim tailpiece screws
18 Cam screws
19 Cam

11-10 Exploded view of the ASSA Twin 6000 high-security mortise cylinder. ASSA

ASSA

11-11
The unique ASSA key.

As shown in Fig. 11-10, the ASSA Twin 6000 cylinder supplies two pinning arrangements in one cylinder. It is a standard cylinder and a sidebar lock in one. Item 11 in Fig. 11-10 shows the sidepins that are installed into the bottom side of the plug. All of these pins are exactly the same height and diameter. Each sidepin contains false grooves to resist manipulation and one operating or open groove. The sidebar legs or projections slip into the operating groove when the properly coded key is put into the plug. Each coded sidebar bitting on the key will raise each sidepin to the proper height and align its operating groove with the sidebar leg opposite it. This in turn allows the sidebar to retract all the way into the plug. Then the cuts at the top of the ASSA key blade must raise the regular pin tumblers to the shearline, which allows the plug to be rotated.

The pin tumbler depth-numbering system in the ASSA cylinder is quite different from conventional systems. In the ASSA system a #1 pin is the longest pin and a #9 pin is the shortest pin. In standard pinning a #9 would be the longest and a #1 would be the shortest. The key spacing positions are also numbered in reverse. A #1 cut is measured from the tip of the key and a #6 cut is closest to the shoulder of the key, while in standard spacing a #1 cut would be measured from the shoulder.

ASSA cylinders also use an arranged constant stack height, through the use of corresponding bottom and top pins, or *spool drivers* as they are called by ASSA. There are only four sizes of top pins. For example, spool driver A would be used with a #1 and a #2 bottom pin, spool driver B would be used with a #3 and a #4 bottom pin, and so forth. The master pins in the ASSA cylinder, of which there are only six, also correspond to and are configured in with both top and bottom pins to retain that same constant stack height. The spool drivers are made of stainless steel, while the bottom and master pins are made of nickel silver.

Key control

ASSA has been awarded two separate patents on its key that are separate from the ASSA cylinder. This alleviates the danger of after-market key blanks being made available to the public or unauthorized key cutters and locksmiths. In addition, ASSA has designed four levels of key control for their coded key blanks and sidebars.

Beta

Beta keyways are designed for exclusive use by the locksmith. There are two types of Beta keyways. Beta Regional assigns each locksmith one or more states as their operating boundary. The sidebar code and coded key blank will not be reassigned in that region. Beta National assigns each locksmith one sidebar (two keyways and sidebars are reversible) for the entire country. Both levels require an initial investment.

Gamma

Gamma locksmiths are assigned one sidebar for a small geographical area. This keyway is shared with other dealers throughout the region.

Delta

This level is distributor exclusive with the coded sidebar available to individual locksmiths. The distributor is responsible for control of key blanks at this level.

Alpha

This level is regional or national exclusive, and is licensed directly to the end user.

Servicing and assembly

Figure 11-12 shows the assembly procedures for installing the sidebar and related parts. Notice that these procedures include only the sidebar assembly, which must be performed first. Figure 11-13 shows the procedures for installing the bottom and top pins and related parts in the standard format.

Figures 11-14 and 11-15 show the sidebar and pin tumbler procedures for ASSA Twin 6000 key-in-knob cylinders in a few other manufacturer's locks. All ASSA Twin 6000 cylinders (key-in-knob, mortise, rim, etc.) can be retrofitted into most other products.

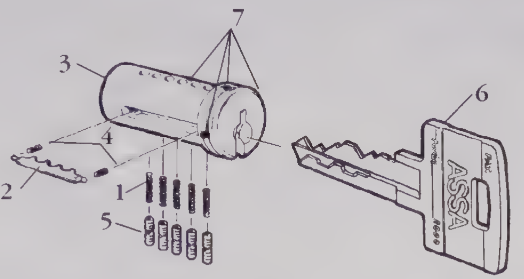
Figure 11-16 shows an ASSA pin kit. This pin kit includes all the parts and tools needed to service these cylinders. Figures 11-17 through 11-19 show some of the ASSA product line.

MUL-T-LOCK HIGH-SECURITY CYLINDER

The Mul-T-Lock high-security cylinder is a "pin-within-a-pin" pin tumbler lock cylinder. This design is one of the most distinctive approaches to a high-security pin tumbler lock. The pinning technology for Mul-T-Lock cylinders is the plug pins and the body pins, including external plug pins. The plug pins are bottom pins, as shown in Fig. 11-20. This design offers one of the most effective deterrents to lock picking.

Design and construction

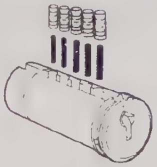
The body pins comprise the disks for master keying and the combined pins. There is one length of the combined pin that acts as the top pin for both the external and internal disks and plug pins. The external pin stack is spring loaded in the same



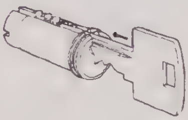
1 Side pin springs
2 Side bar
3 Cylinder plug
4 Side bar springs
5 Side pins
6 Key
7 Drill resistant pins

Side bar assembly method is the same for all ASSA Twin 6000 cylinders.

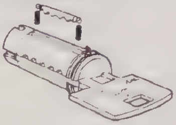
1. Turn cylinder plug upside down. Insert the side pin springs into the pin holes.
   Note: These pin holes are drilled from the bottom side of the cylinder plug.
2. Insert the side pins with the hollowed end towards the spring. Be sure that the springs and pins are properly seated in the recesses. If a spring or pin is jammed, the cylinder will not function.
   Note: All side pins are the same.



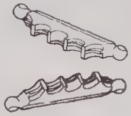
3. Keep the cylinder plug upside down and insert a key or a key blank to keep the side pins in place.
   Note: Depress side pins in order to insert the key.



4. Insert the short springs (side pin springs) in the small holes at each end of the groove along the cylinder plug for the side bar. Be sure that springs seat correctly.

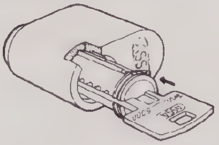


5. Place the side bar so that the shelves (lug) correspond to the deep waists of the side pins. Press the side bar into the groove so that it can be fully depressed into the cylinder plug.
   Note: The key should be kept in the cylinder plug at all times during assembly.

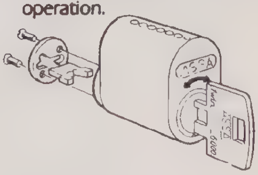


If side bar does not fully depress into the cylinder plug, side bar may be inverted.

6. Slide the cylinder plug into the cylinder housing. If the position of the side bar is correct, the cylinder plug will turn. Hold the cylinder plug in place when drawing out the key.



7. Fasten the tail piece and the tail piece washer. After assembly, test the cylinder for proper operation.



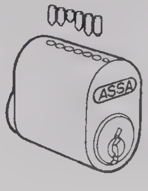
ASSA

11-12 The side bar assembly method for all ASSA Twin 6000 cylinders.

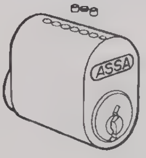
fashion as a standard pin tumbler lock mechanism. However, the internal pin stack is spring loaded by the combined pin, which is a specialized external top pin that has a built-in, permanently spring-loaded internal pin.

The bottoms of the external body pins are concave to match the contour of the cylinder body. The tops of the external plug pins are convex and form a spherical

1. Insert the bottom pins as per the bitting sheet.

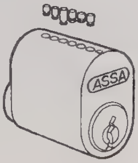


2. In case of master-keyed cylinders, master pins are placed over the bottom pins as stated, according to bitting requirements.

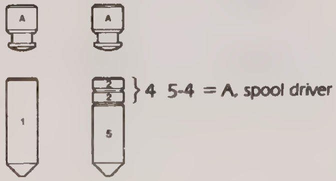


3. Spool drivers must correspond to the length of the bottom pins and are then inserted into the cylinder housing as follows:

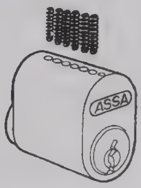
Spool top pin A for bottom pin 1-2
" B " 3-4
" C " 5-6
" D " 7-8-9



Note: In pin chambes with bottom pin and master pins the total length of the bottom and master pins determines the length of the spool drivers. (see example)

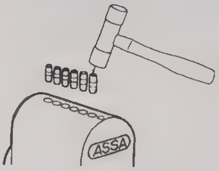


4. Cylinder springs are placed over each spool driver in the cylinder housing.



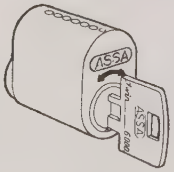
5. Insert the closing plugs. Press the plugs down until they are flush with the top of the cylinder housing.

Note: Care should be taken not to damage the finish of the cylinder if hammering.
Other methods of plugging applies to other types of ASSA cylinders.



6. For lubricating, use only ASSA spray.

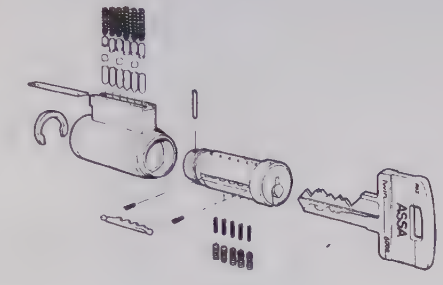
7. After assembling, test the cylinder function for proper operation.



ASSA

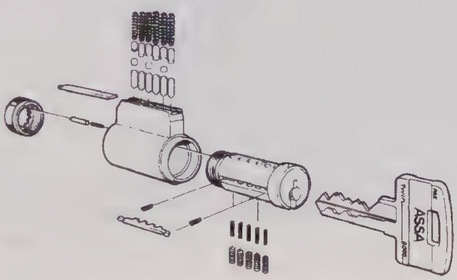
11-13 Pin loading procedure for ASSA Twin 6000 cylinders.

shape. This shape matches the contour of the plug body. The concave shape of the body pins and the convex shape of the plug pins, when properly aligned, form a three-dimensional shearline. This spherical shearline enables tighter lock-cylinder tolerances, which improves key operation and pick resistance.



65655 Russwin

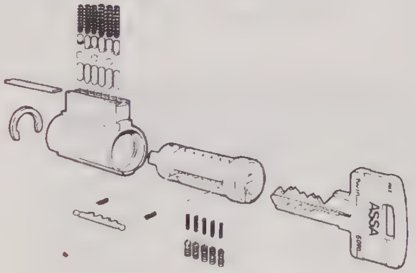
1. Install cylinder plug in housing as shown in diagram.
2. Install cylinder retaining clip from above and ensure it is well seated.
3. Insert rollpin from above to allow installation of original manufacturers tailpiece.



65661 Falcon

1. Install cylinder plug in housing as shown in diagram.
2. Special tailpiece washer provided by ASSA. Use original manufacturers drive bar to complete assembly.
3. When installing tailpiece depress cylinder cap pin and tighten cap clockwise until it is tight, then back off one or two notches.

Note: The cap must be properly adjusted. If cap is too loose the key cannot be withdrawn because cylinder plug and cylinder housing pin chamber will not line up properly. If the cylinder cap is too tight the cylinder will be difficult to operate.



65671 Sargent

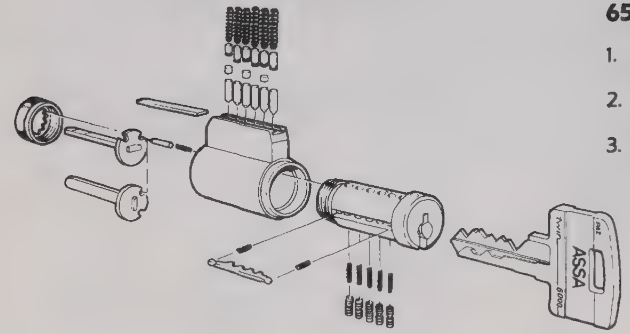
1. Install cylinder plug in housing as shown in diagram.
2. Install cylinder retaining clip from above and ensure it is well seated.

ASSA

11-14 Pinning and side bar assembly procedures for the ASSA Twin 6000 key-in-knob cylinders that retrofit Russwin, Falcon, and Sargent locks.

There are four lengths of external plug pins identified as A, B, C, and D. There are five lengths of internal plug pins identified as 1, 2, 3, 4, and 5 (Fig. 11-21). Internal and external plug pins are identified by letter and number combination. For example, external plug pin B can have an internal plug pin 2. This complete plug pin would be identified as B2. There are 11 factory-determined internal and external plug-pin combinations.

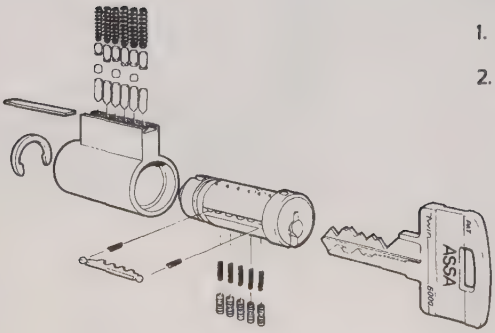
1. **Insert the side bar mechanism, bottom pins, master pins and springs with same method as described earlier.**
2. **Insert pin chamber closing strip into pin bible and then "stake" with a small chisel or similar tool so the strip will remain in position.**
3. **After cylinder assembly is completed, test for proper operation before installing in lockset.**



65611 Schlage

1. Break off tailpiece provided to accomodate different functions. Cut to proper length at score.
2. The tailpiece can be located in either vertical or horizontal positions.
3. When installing the tailpiece – depress cylinder cap pin and tighten cap clockwise until it is tight, then back off one of two notches.

Note: *The cap must be properly adjusted. If cap is too loose the key cannot be withdrawn because cylinder plug and cylinder housing pin chamber will not line up properly. If the cylinder cap is too tight the cylinder will be difficult to operate.*



65631 Yale

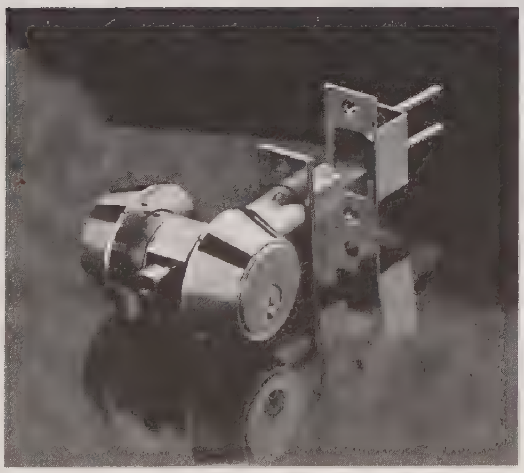
1. Install cylinder plug in housing as shown in diagram.
2. Install cylinder plug retaining clip from above and ensure it is well seated.

11-15 Pinning and side bar assembly procedures for the ASSA Twin 6000 key-in-knob cylinders that retrofit Schlage and Yale locks. ASSA

There are three lengths of external disks and four lengths of internal disks for master keying, as well as three lengths of solid disks. The disks are identified by number 1, 2, and 3. The solid disks have a "+" before the number. For example, a number 3 solid disk would be identified as +3. There is no MACS restriction on Mul-T-Lock pins.

ASSA

11-16 An ASSA pin kit.

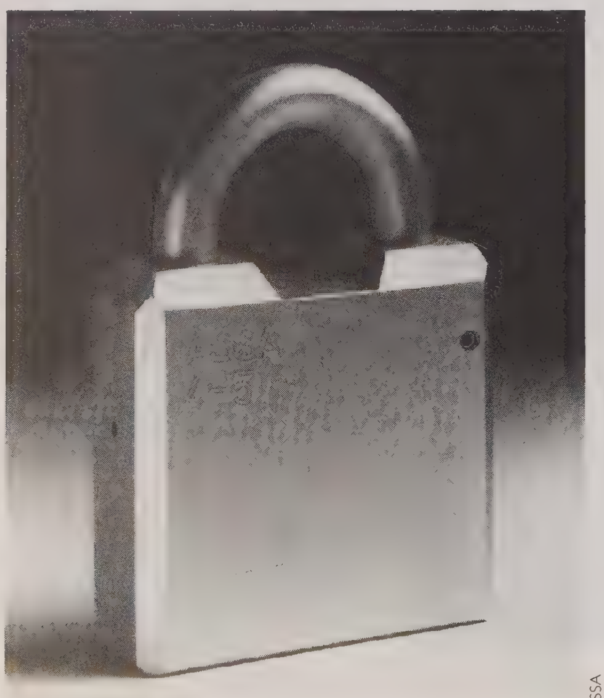


ASSA

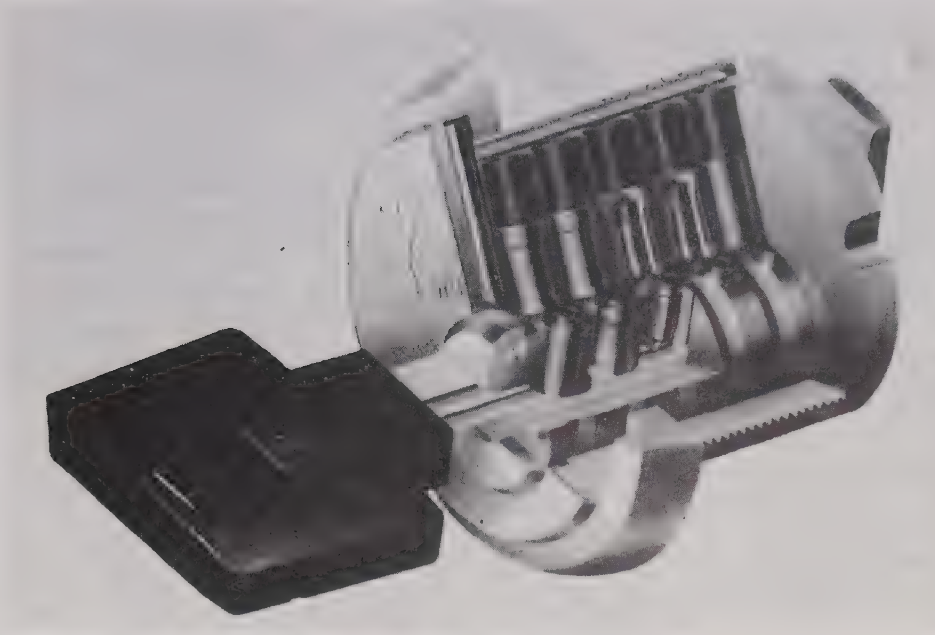
11-17
An ASSA high-security deadbolt.

ASSA

11-18 ASSA padlocks.


ASSA

11-19
An ASSA high-security padlock.



Mul-T-Lock

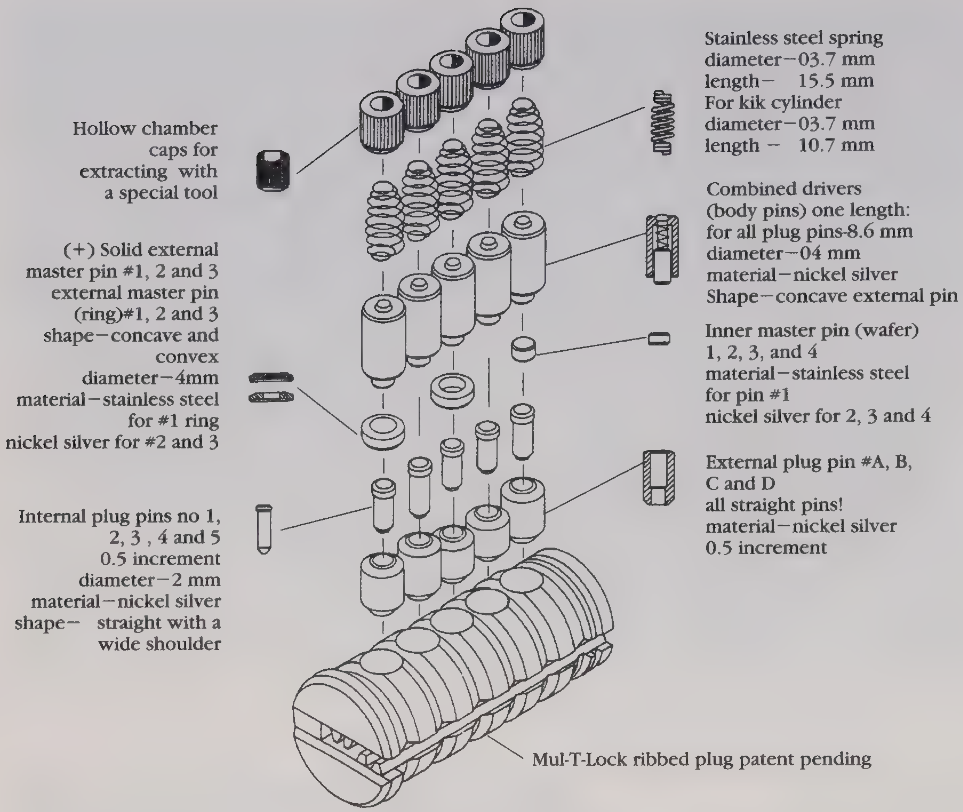
11-20 Inside view of a Mul-T-Lock mortise cylinder.

Mul-T-Lock keys

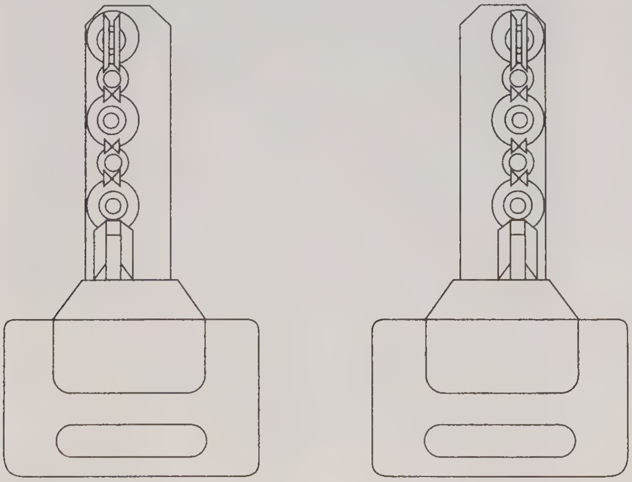
The double-sided convenience-type key has the same cuts on both sides of the blade (Fig. 11-22). The tip stop is used for originating. There is no shoulder stop. The sets of cuts are numbered 1 through 5 and measured from bow to tip. In a four-pin set key-in-knob cylinder the #1 cut is not used. Cut-to-cut spacing is constant. The keys are available in nickel silver and with a plastic head. Plastic-head keys, for master-keying applications or to identify specific keys, are available in 10 colors. Since only one side of the key operates a lock, these double-sided keys can operate to different code combinations. A small protrusion is molded into one side of the plastic key head. This protrusion can be used to distinguish one side of a key from another.

Each Mul-T-Lock key contains a maximum of five double cuts on each side of the blade. A double dimple cut is two separate cuts: one to accommodate the depth requirement of the internal pin length and one to accommodate the depth requirement of the external pin length.

Unlike other high-security keys, the Mul-T-Lock key enters the keyway in a horizontal position. The blade of the key is approximately .355 inch wide. The cuts in the key are offset with the center of each cut approximately .100 inch from the blade's edge. The keyway is offset within the plug in order for the cuts to line up with the pin tumblers located in the center of the lock cylinder. This design enables Mul-T-Lock to offer left-hand and right-hand combinated cylinders and keys. In addition, sectional keyways are available for specific applications.


Stainless steel spring
diameter—03.7 mm
length— 15.5 mm
For kik cylinder
diameter—03.7 mm
length — 10.7 mm
Hollow chamber caps for extracting with a special tool
Combined drivers (body pins) one length: for all plug pins-8.6 mm
diameter—04 mm
material—nickel silver
Shape—concave external pin
(+) Solid external master pin #1, 2 and 3
external master pin (ring)#1, 2 and 3
shape—concave and convex
diameter—4mm
material—stainless steel for #1 ring
nickel silver for #2 and 3
Inner master pin (wafer) 1, 2, 3, and 4
material—stainless steel for pin #1
nickel silver for 2, 3 and 4
External plug pin #A, B, C and D
all straight pins!
material—nickel silver
0.5 increment
Internal plug pins no 1, 2, 3 , 4 and 5
0.5 increment
diameter—2 mm
material—nickel silver
shape— straight with a wide shoulder
Mul-T-Lock ribbed plug patent pending

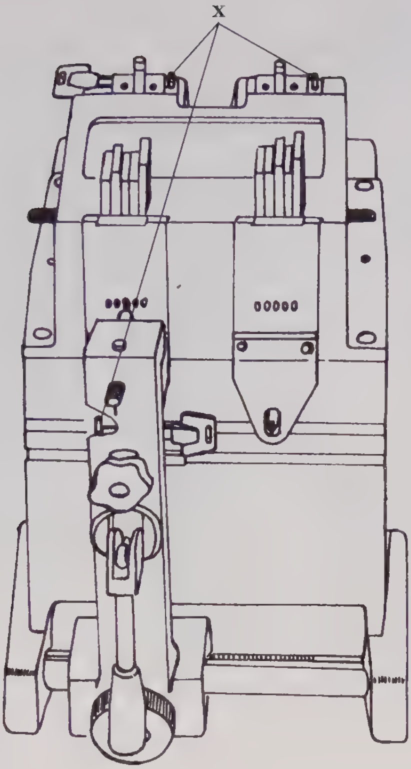
11-21 Exploded view of Mul-T-Lock's pin inside a pin arrangement, and associated parts. The Locksmith Publishing Co.



On a left-hand key grooves and cuts will appear on the left

On a right-hand key grooves and cuts will appear on the right

11-22
The Mul-T-Lock key.
Mul-T-Lock



11-23
The Mul-T-Lock key cutting machine, for cutting Mul-T-Lock keys only. Mul-T-Lock

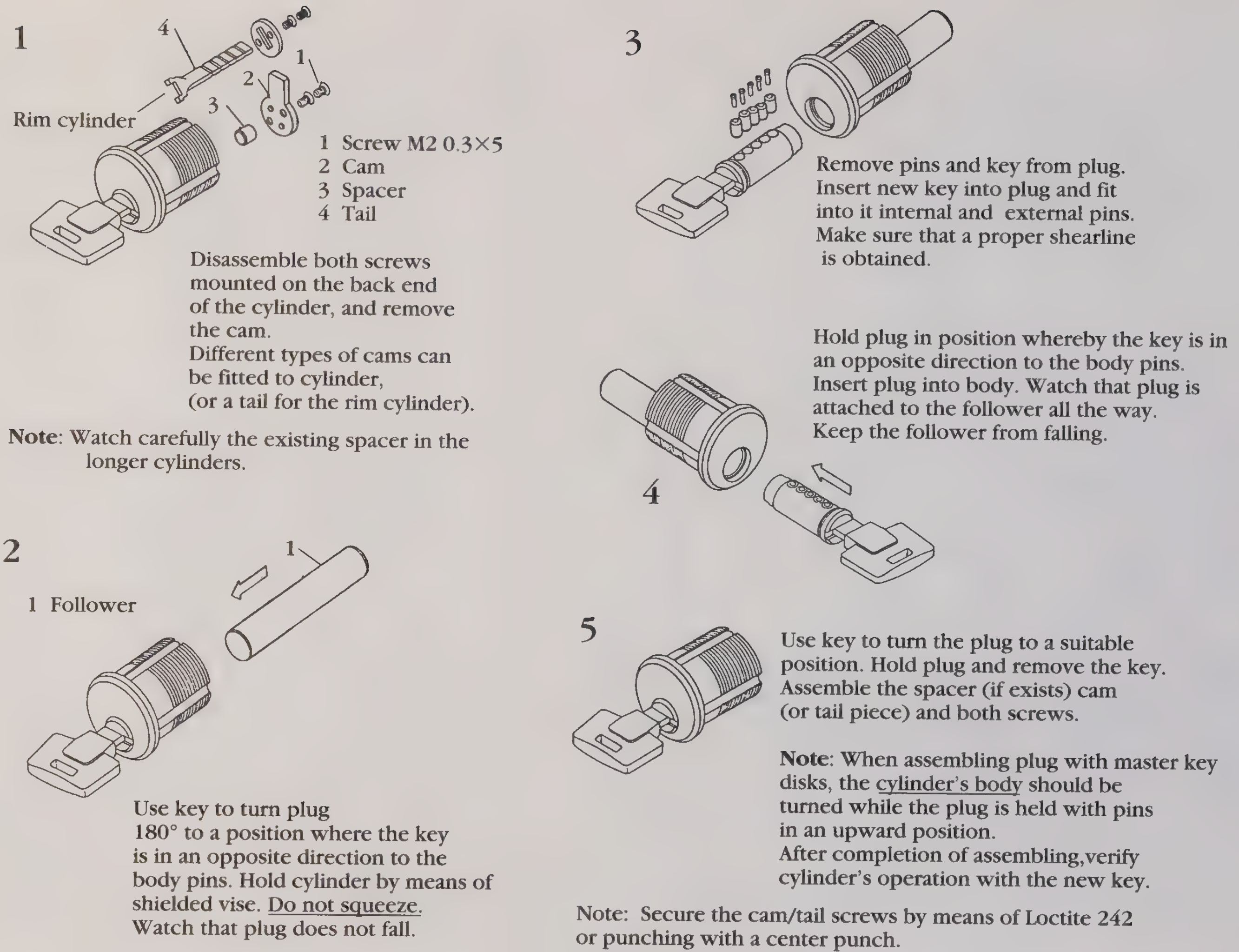
Mul-T-Lock key cutting

The dimple cuts on a Mul-T-Lock key are cut using a special Mul-T-Lock key-cutting machine. No other keys can be cut on this machine (Fig. 11-23). This machine originates keys by using two spindle-mounted cutters, one cutter for the external pins and one for the internal pins. The depths of the cuts are controlled by two cams mounted on the top of the key machine. Spacing is determined by the alignment of the carriage with space locating tabs.

Figure 11-24 shows the bottom internal and external pinning procedures for Mul-T-Lock mortise and rim cylinders. Figure 11-25 shows the pinning procedures for Mul-T-Lock key-in-knob cylinders. All Mul-T-Lock cylinders can be retrofitted into other manufacturers' lock products.

Mul-T-Lock padlocks

Mul-T-Lock padlocks are unique as far as standard padlocks are constructed. This is because the entire padlock assembly must be removed to rekey the padlock cylinder. Figure 11-26 shows the rekeying procedures for Mul-T-Lock's Pop-Open Shackle Padlock No. 10.



1 Screw M2 0.3×5
2 Cam
3 Spacer
4 Tail

Disassemble both screws mounted on the back end of the cylinder, and remove the cam.
Different types of cams can be fitted to cylinder, (or a tail for the rim cylinder).

Note: Watch carefully the existing spacer in the longer cylinders.

1 Follower

Use key to turn plug 180° to a position where the key is in an opposite direction to the body pins. Hold cylinder by means of shielded vise. Do not squeeze.
Watch that plug does not fall.

Remove pins and key from plug.
Insert new key into plug and fit into it internal and external pins.
Make sure that a proper shearline is obtained.

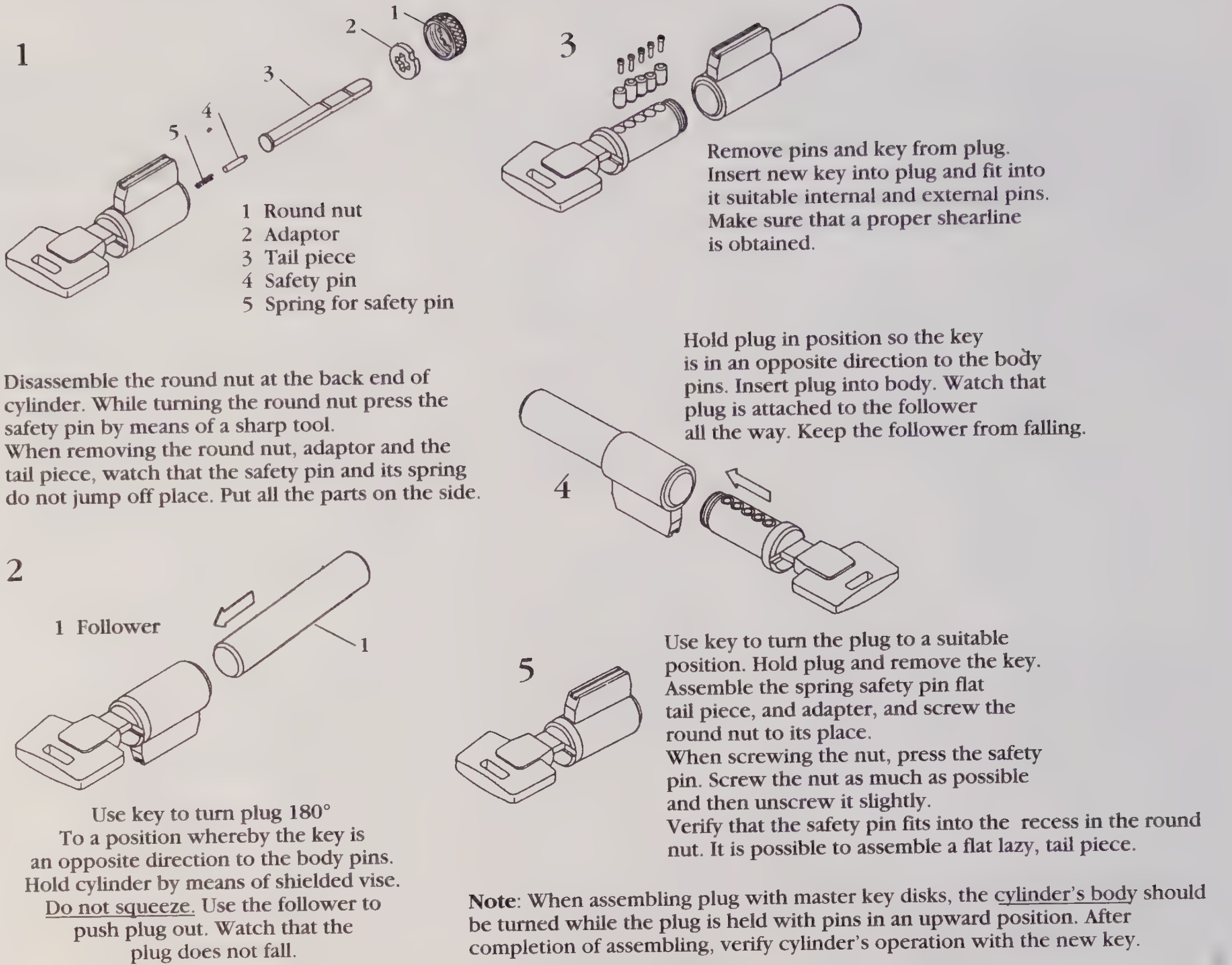
Hold plug in position whereby the key is in an opposite direction to the body pins.
Insert plug into body. Watch that plug is attached to the follower all the way.
Keep the follower from falling.

Use key to turn the plug to a suitable position. Hold plug and remove the key.
Assemble the spacer (if exists) cam (or tail piece) and both screws.

Note: When assembling plug with master key disks, the cylinder's body should be turned while the plug is held with pins in an upward position.
After completion of assembling,verify cylinder's operation with the new key.

Note: Secure the cam/tail screws by means of Loctite 242 or punching with a center punch.

11-24 Rekeying procedures for Mul-T-Lock mortise and rim cylinders. Mul-T-Lock



1 Round nut
2 Adaptor
3 Tail piece
4 Safety pin
5 Spring for safety pin

Disassemble the round nut at the back end of cylinder. While turning the round nut press the safety pin by means of a sharp tool.
When removing the round nut, adaptor and the tail piece, watch that the safety pin and its spring do not jump off place. Put all the parts on the side.

1 Follower

Use key to turn plug 180°
To a position whereby the key is an opposite direction to the body pins. Hold cylinder by means of shielded vise. Do not squeeze. Use the follower to push plug out. Watch that the plug does not fall.

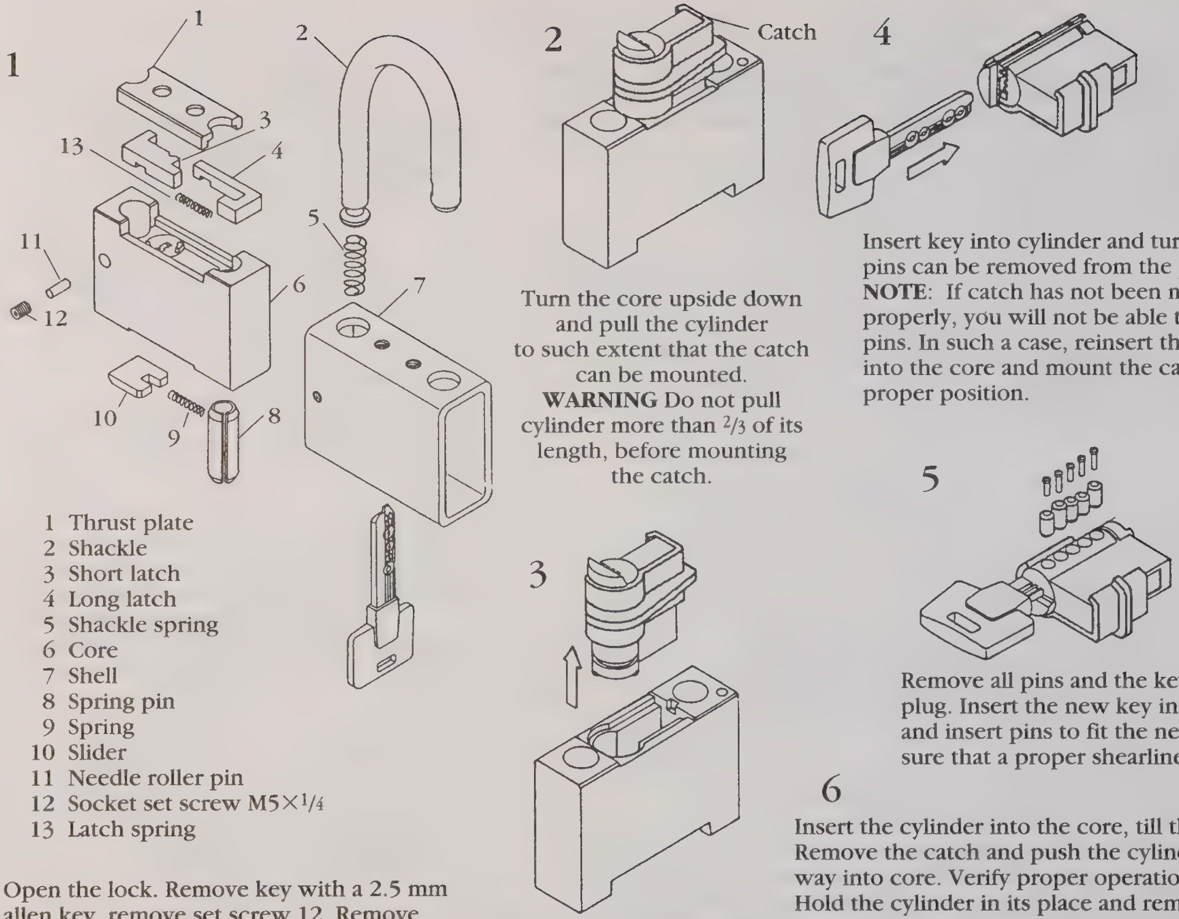
Remove pins and key from plug.
Insert new key into plug and fit into it suitable internal and external pins. Make sure that a proper shearline is obtained.

Hold plug in position so the key is in an opposite direction to the body pins. Insert plug into body. Watch that plug is attached to the follower all the way. Keep the follower from falling.

Use key to turn the plug to a suitable position. Hold plug and remove the key. Assemble the spring safety pin flat tail piece, and adapter, and screw the round nut to its place.
When screwing the nut, press the safety pin. Screw the nut as much as possible and then unscrew it slightly.
Verify that the safety pin fits into the recess in the round nut. It is possible to assemble a flat lazy, tail piece.

Note: When assembling plug with master key disks, the cylinder's body should be turned while the plug is held with pins in an upward position. After completion of assembling, verify cylinder's operation with the new key.

11-25 Rekeying procedures for Mul-T-Lock key-in-knob cylinders. Mul-T-Lock



1 Thrust plate
2 Shackle
3 Short latch
4 Long latch
5 Shackle spring
6 Core
7 Shell
8 Spring pin
9 Spring
10 Slider
11 Needle roller pin
12 Socket set screw M5×1/4
13 Latch spring

Open the lock. Remove key with a 2.5 mm allen key, remove set screw 12. Remove needle roller pin 11, and slide out shackle. Slide out core, taking care not to lose spring-loaded parts.

Turn the core upside down and pull the cylinder to such extent that the catch can be mounted. **WARNING** Do not pull cylinder more than 2/3 of its length, before mounting the catch.

Remove cylinder together with the catch.

Insert key into cylinder and turn it until the pins can be removed from the plug. **NOTE**: If catch has not been mounted properly, you will not be able to remove the pins. In such a case, reinsert the cylinder into the core and mount the catch in the proper position.

Remove all pins and the key from the plug. Insert the new key into the plug, and insert pins to fit the new key. Make sure that a proper shearline is obtained.

6

Insert the cylinder into the core, till the catch. Remove the catch and push the cylinder all the way into core. Verify proper operation of cylinder. Hold the cylinder in its place and remove the key. Complete assembly of all lock parts and slide core into shell. Verify lock's operation prior to insertion of the shackle. Insert the shackle into lock and complete assembly. Check proper function of padlock.

11-26 Rekeying procedures for Mul-T-Lock's Pop Open Shackle Padlock No. 10. Mul-T-Lock

Key control

Key-cutting of Mul-T-Lock keys is controlled by an embossed identification card. A card is issued with each keyed cylinder. Mul-T-Lock keys can only be code cut as new originals, and only on the special Mul-T-Lock key-cutting machine, which makes duplication more difficult. To get a key cut, the owner of the key must sign a Restricted Key Order Form. The locksmith then compares the signature on the form to the signature on the identification card. If the locksmith determines that both signatures are identical, he or she can then originate a new key according to the code on the card. This process prevents someone from having someone else's key duplicated without authorization.

12

Door closers

Locksmiths spend a considerable amount of time installing and servicing door-control products. In commercial environments, door control has become such a big business that many locksmiths and hardware specialists do nothing but door control servicing. Some of these products go beyond basic mechanical door control. Some of these products are powered electrically, some contain smoke detectors, and some can be tied into existing burglar and fire alarm systems for automatic emergency egress. The most common products include:

- door closers: mechanical and electrical
  - ~ surface-applied closers
  - ~ overhead concealed closers
  - ~ floor-concealed closers
  - ~ pivots
  - ~ holder and release devices
- exit devices
  - ~ concealed vertical rod
  - ~ rim
- door coordinators

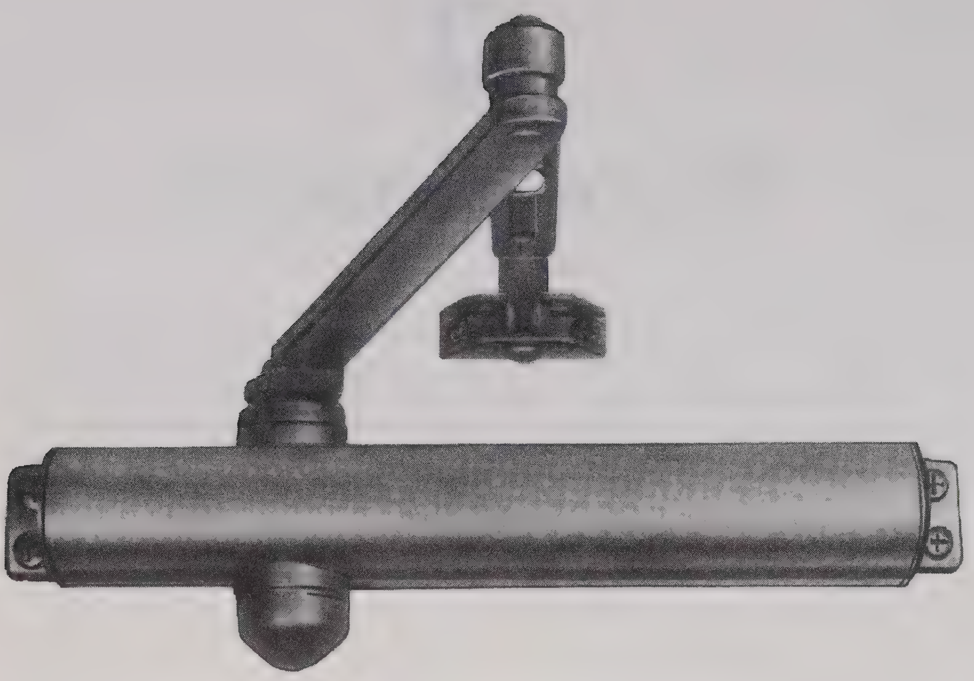
SURFACE-APPLIED CLOSERS

The surface-applied door closer is one of the most common closers on the market. This type of door closer is installed on the top surface of a door or, in certain situations, on the top header of a door jamb (Fig. 12-1). Surface-applied closers, however, have two major drawbacks. They are completely visible and they only can be installed on single-acting doors (doors that swing only one way).

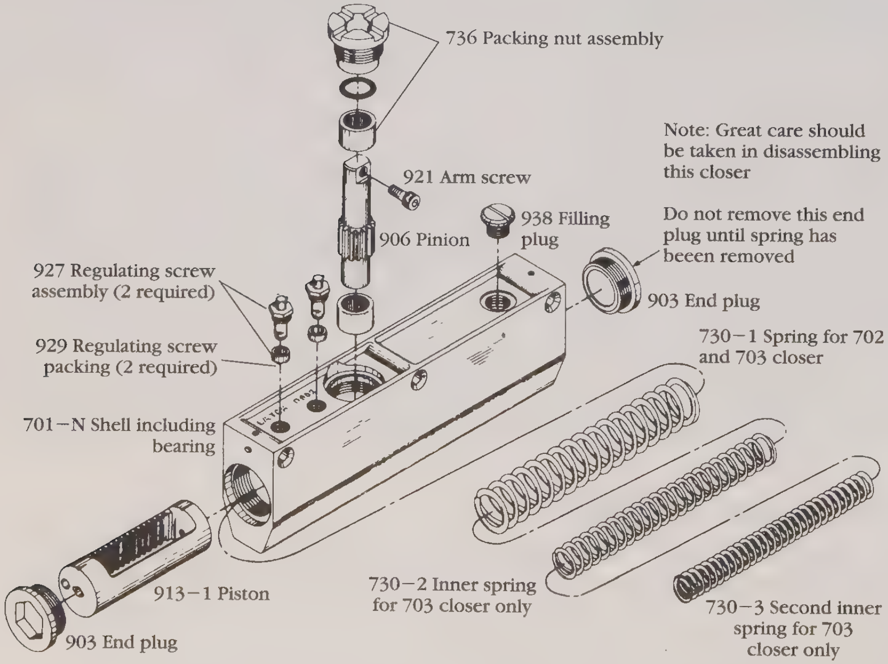
Surface-applied closers come in a variety of prices, sizes, shapes, and functions. The cheaper models offer the most basic of functions, usually do not last very long, and require considerable maintenance. The more expensive closers make up for the extra cost with additional functions, low maintenance requirements, and durability.

Basic construction and operation

The main function of a door closer is to close the door after it has been released. A door closer must be able to control against unnecessary backswinging (back check), close the door slowly (sweep) at all times and against specific wind conditions, and control the latching speed (latch) of the door. As shown in Fig. 12-2, the typical surface-applied closer contains specific parts to meet these three basic functions.



12-1 Norton's Series 8000 regular arm door closer. Yale Security, Inc.


736 Packing nut assembly
921 Arm screw
938 Filling plug
906 Pinion
927 Regulating screw assembly (2 required)
929 Regulating screw packing (2 required)
903 End plug
730−1 Spring for 702 and 703 closer
701−N Shell including bearing
913−1 Piston
903 End plug
730−2 Inner spring for 703 closer only
730−3 Second inner spring for 703 closer only

Note: Great care should be taken in disassembling this closer

Do not remove this end plug until spring has beeen removed

12-2 Exploded view of a typical surface-mounted door closer. The Locksmith Publishing Co.

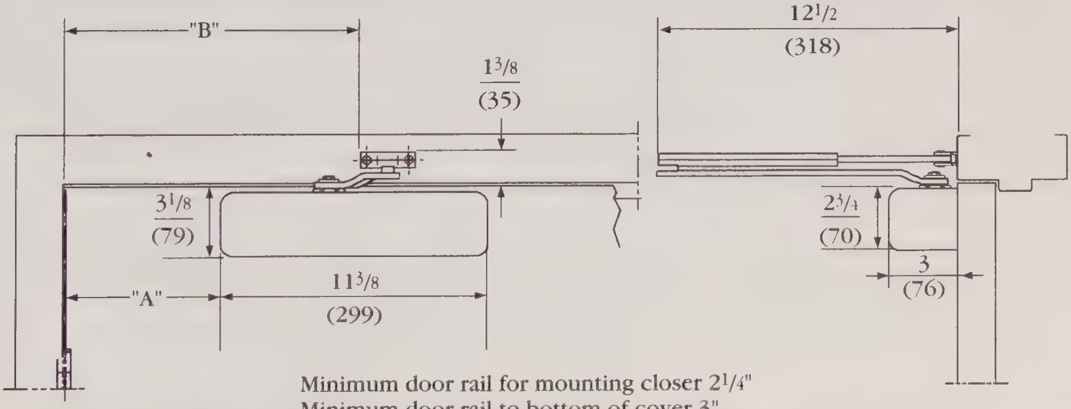
When the door is opened, a pinion shaft inside the closer turns and forces the piston, or rack, to travel towards the opposite closure chamber. This action controls the opening force of the door. The moving of the pinion also compresses the spring assembly and allows the hydraulic fluid to flow into the other chamber. When the door is released, the compressed spring begins to decompress and forces the piston and fluid back to its original position. It is this action that closes the door. The speed and pressure at which the closer reacts is controlled by adjustment valves built into each closer that regulate the amount of fluid that flows through the chambers as the closer goes through its full range of operation. An optional back-check valve supplies a hydraulic cushion that prevents the door from being opened too far. An adjustable sweep-speed valve regulates the general closing speed of the door. A latch-speed regulating valve determines when and how fast the door will increase its closing speed to enable lock latching.

Mounting procedures

Surface-applied closers are mounted on the pull side of the door, near the top of the door and the top hinge. They can be mounted in three different ways, although there are other mounting positions and methods that meet specific applications. The three main mounting positions are regular-arm, parallel-arm, and top-jamb.

Although some manufacturers' instructions might vary, most mounting methods for surface-applied closers are basically the same. The only differences might be the positioning dimensions from the door hinge or the positioning dimensions of the arm bracket. Figures 12-3, 12-4, and 12-5 show the mounting dimensions for Dorma's 7800/4800/6800 Series door closers. Some installation sheets come with an installation template. Steps 1 through 7 show additional procedures that you should take when you install surface-applied closers.

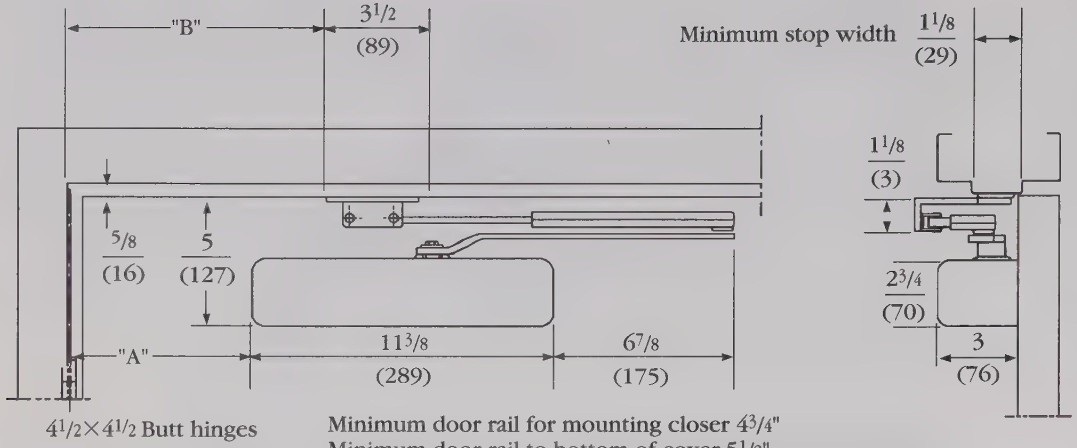
1. Follow mounting dimensions supplied with each closer.
2. Use tape at the drill-point locations to prevent damage to the jamb and surface of the door.



4 1/2×4 1/2 Butt hinges

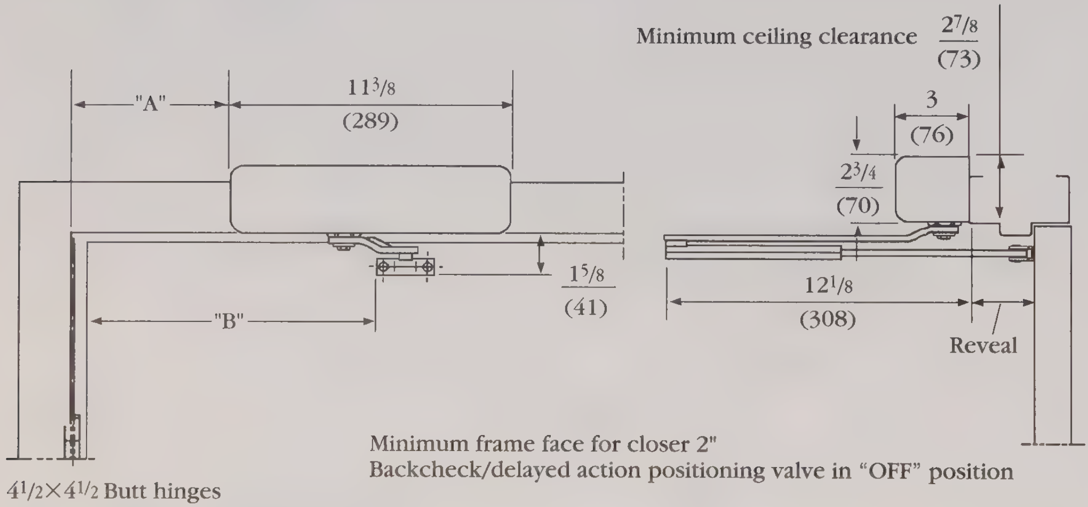
Minimum door rail for mounting closer 2 1/4"
Minimum door rail to bottom of cover 3"
Backcheck/delayed action positioning valve in "OFF" position

12-3 Regular installation mounting dimensions for Dorma's 7800/4800 series closers. The Dorma Group



Minimum door rail for mounting closer 4 3/4"
Minimum door rail to bottom of cover 5 1/2"
Backcheck/delayed action positioning valve in "ON" position

12-4 Parallel arm installation mounting dimensions for Dorma's 7800/4800 series closers. The Dorma Group



Minimum frame face for closer 2"
Backcheck/delayed action positioning valve in "OFF" position

12-5 Top jamb installation mounting dimensions of Dorma's 7800/4800 series closers. The Dorma Group

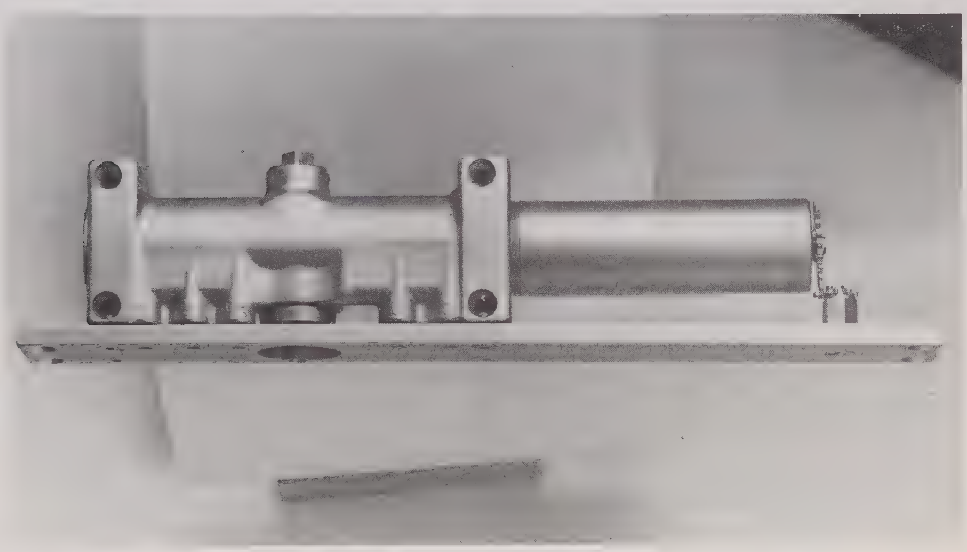
3. On metal jambs and doors, use a center punch to start drill-point locations. This avoids bit sliding.
4. Never drill holes all the way through the door (unless you're using through bolts), and take care to use a drill bit that is smaller than the mounting screws.
5. Make sure the pinion of the closer is towards the hinge side of the door for regular-arm mounting.
6. Adjust the arm assembly by threading the forearm in or out so that the

forearm lies perpendicular to the door. (Some models might require that it lie slightly off perpendicular.)

7. Adjust the closing and latching speeds. A comfortable and safe adjustment is a minimum five-second closing (sweep) time and a two-second latch time.

OVERHEAD CONCEALED CLOSERS

Overhead concealed closers are installed inside the top header of a door frame and can be used on single-acting or double-acting doors, which means they can be used for doors that swing either in or out. These closures are commonly installed with the new door and door jamb, but can be replaced or installed after a door and header have been installed (Fig. 12-6).



Yale Security Inc.

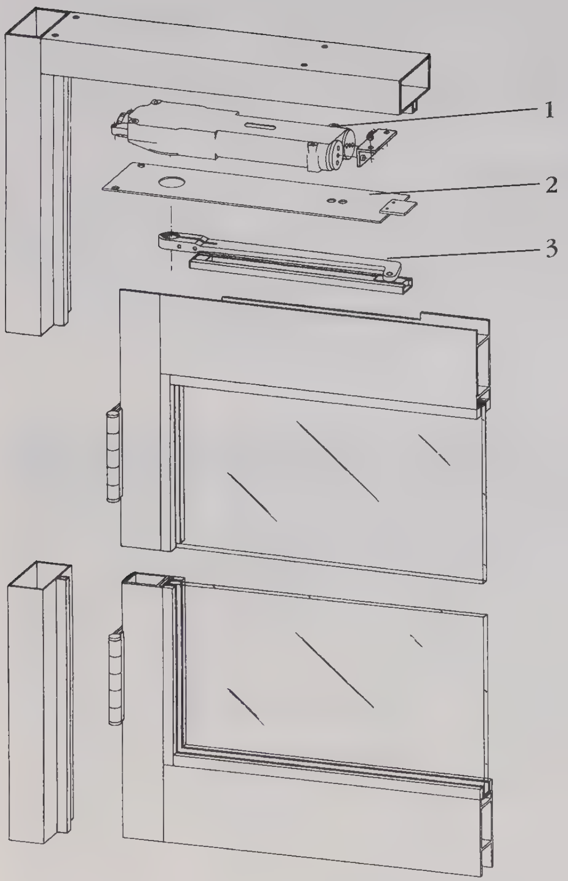
12-6 Norton overhead-concealed door closer.

Basic construction

An overhead concealed closer includes the closer unit, cover plate, top arm, and bottom pivot. Overhead closers come with three different types of arms: the side-load, the end-load, and the offset or slide arm. The slide arm is the most common and the most easy to identify since it has a notch cut out at the top of the hinge side of the door to accommodate the arm. The end-load arm has the end portion of the top of the door cut out. You can see this by opening the door to a 90-degree angle. Figures 12-7, 12-8, and 12-9 show typical side-load, end-load, and offset applications for Dorma's RTS Series.

FLOOR-CONCEALED CLOSERS

Figure 12-10 shows a floor-concealed closer, which is used primarily to maintain an aesthetic appearance. Floor closers can be used for heavier door applications and



Package RTS−25 is templated specifically for aluminum doors hung on 4½" wide hinges.

Components:RTS−25

1 RTS Series closer
2 No. 8563 Cover plate (optonal)
3 No. 8810 Slide arm

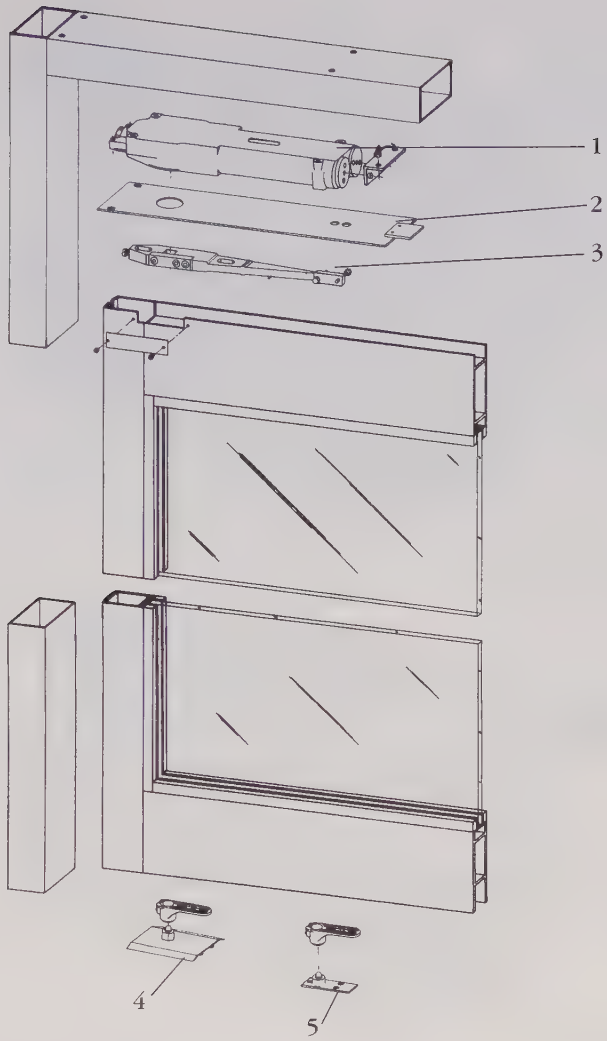
12-7 Side load configuration for Dorma's RTS series packages. The Dorma Group

can accommodate up to 1,500 pounds. They are also more durable, which keeps maintenance to a minimum. Floor closers are either single-acting or double-acting and come in two basic models: offset-hung or center-hung. A single-acting closer allows the door to swing open only one way, while the double-acting closer allows the door to swing in both directions.

Offset floor-concealed closers allow the pivot point of the door to be offset ¾ inch from the heel edge of the door and ¾ inch from the face of the door. 1½-inch offset floor closers locate the pivot point ¾ inch from the heel edge of the door and 1½ inches from the face of the door. Figures 12-11 and 12-12 show a center-hung concealed floor closer and an offset-hung concealed closer, respectively.

Troubleshooting floor-concealed closers

The following are some of the most probable causes of floor-concealed closer problems and the servicing procedures that can be taken to alleviate them. These servicing procedures are for Rixon-type floor closers, Models 21, 26, 28, 40.



Side load doors are installed by placing the door on the bottom pivot with the door in the closed position. The top of the door has a notch on the interior side that allows access to the clamping block.

Components:RTS–01

1 RTS Series closer
2 No. 8563 Cover plate (optional)
3 No. 8831 Top arm
4 No. 8572 Threshold pivot

Components:RTS–02

1 RTS Series closer
2 No. 8563 Cover plate (optional)
3 No. 8831 Top arm
5 No. 8570 Floor pivot

12-8 Offset slide arm configuration for Dorma's RTS series packages. The Dorma Group

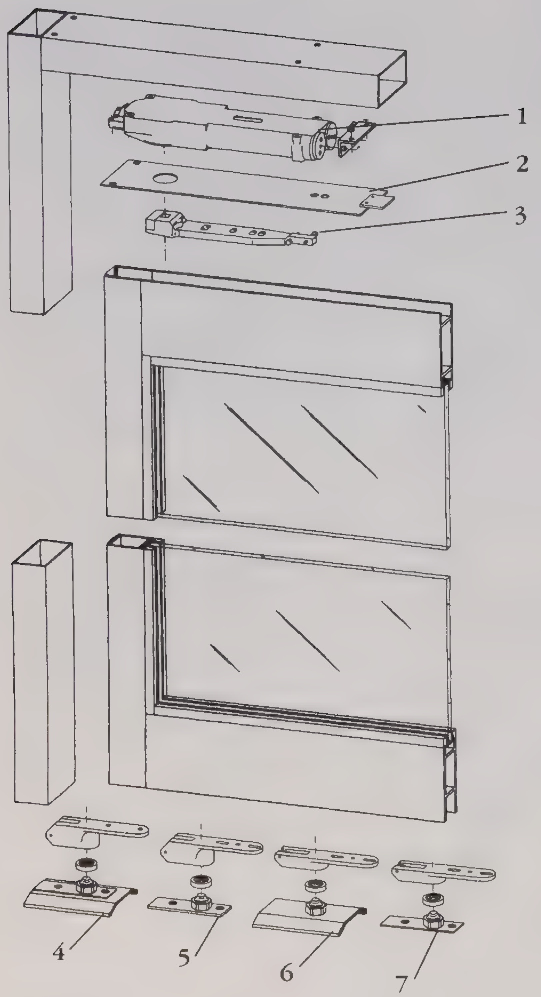
Symptom #1

The door does not close fully.

- **Cause:** Door is binding on head frame, weather strip, or jambs.
- **Remedy:** Check the top pivot and spindle for proper alignment. Also check for proper closer mounting (mortising of arm and pivot).

- **Cause:** Draft condition.
- **Remedy:** Adjust the spring tension to reduce natural draft conditions.

- **Cause:** Arm not properly centered.
- **Remedy:** Loosen and tighten the arm-alignment screws to center the door.



12-9 End-load configuration for Dorma's RTS series packages. The Dorma Group

Packages RTS−07 through RTS−10 are designed for top door rails wtih 1" deep channels. The door is installed by rotating the closer spindle 90° then sliding the door into place, perpendicular to the frame.

Components: RTS−07

1 RTS Series closer
2 No. 8563 Cover plate (optional)
3 No. 8835 Top arm
4 No. 8857 Tall threshold pivot

Components: RTS−08

1 RTS Series closer
2 No. 8563 Cover plate (optional)
3 No. 8835 Top arm
5 No. 8853 Tall floor pivot

Components: RTS−09

1 RTS Series closer
2 No. 8563 Cover plate (optional)
3 No. 8835 Top arm
6 No. 8855 Short threshold pivot

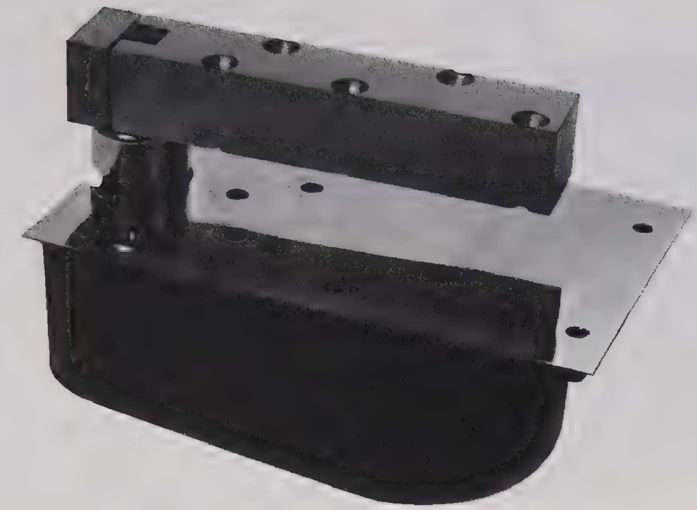
Components: RTS−10

1 RTS Series closer
2 No. 8563 Cover plate (optional)
3 No. 8835 Top arm
7 No. 8852 Short floor pivot

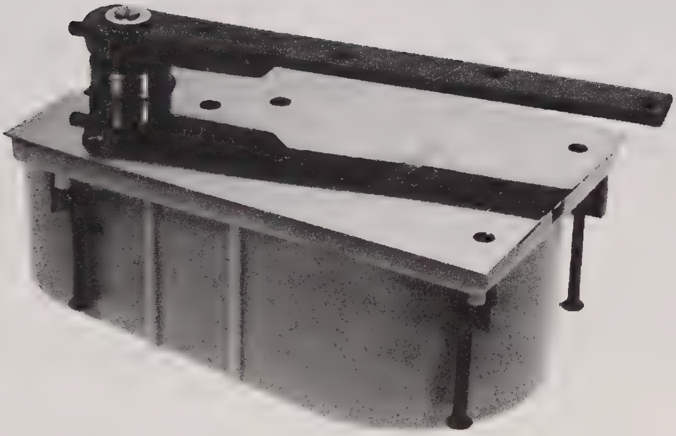
Symptom #2

The door closes too fast or too slow.

- **Cause:** Closer requires adjustment.
- **Remedy:** Some Rixon closers have a single adjustment valve in the center of the closer (Models 21 and 26). Turn this valve either clockwise or counterclockwise to slow or speed up the action. On Rixon Model 28 there are two valves that must be adjusted: the stroke valve and the latch valve. Turn the stroke valve clockwise or counterclockwise to control the action until the door reaches latching position. Adjust the latch valve to adjust the latching action of the door. Rixon Models 30 and 40 have two independent valves that control either the left- or right-hand swing. Adjust them accordingly.



12-10
Rixon's H26 center-hung floor closer. Yale Security, Inc.



12-11
Rixon's 28 × 554 center-hung floor closer. Yale Security, Inc.

Symptom #3

The door slams just before closing.

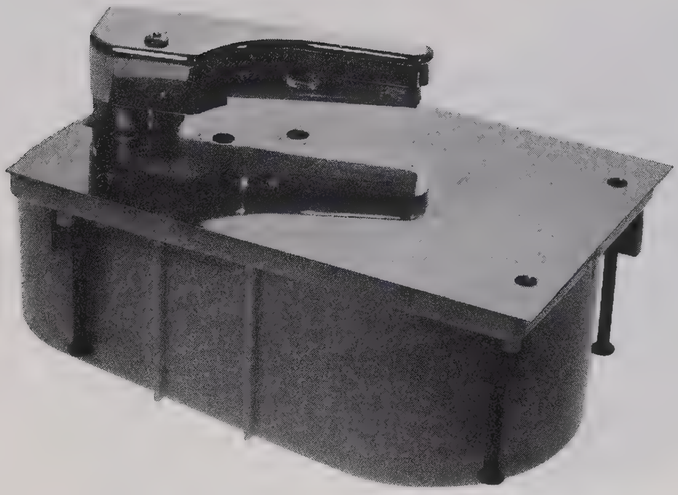
- **Cause:** Latch valve requires adjustment.
- **Remedy:** Adjust latch valve.

- **Cause:** Arm-alignment screws loose.
- **Remedy:** Tighten arm-alignment screws.

Symptom #4

Door closes rapidly, does not close, or does not respond to adjustments.

- **Cause:** Loss of hydraulics.
- **Remedy:** Replace or repair closer.



12-12
Rixon's HM27 ¾" offset floor closer. Yale Security, Inc.

- **Cause:** Internal mechanical failure or defect.
- **Remedy:** Replace or repair closer.

Symptom #5
The door is too hard to open.

- **Cause:** Too great a spring tension.
- **Remedy:** Reduce the spring tension. This has to be done carefully, however, since great bodily harm can result. These springs are under great tension. Use the required special wrench and consult factory repair manuals before you perform this adjustment.

- **Cause:** Back-check or hydraulic cushion adjusted too firmly.
- **Remedy:** Adjust back-check valve, or increase closing speed (Models 30 and 40).

Symptom #6
The door drags on the floor or scrapes against threshold.

- **Cause:** Vertical adjustment needed.
- **Remedy:** Place shims on top of the arm plate to raise door, or reset the cement case to the needed height. Check top pivot mounting.

13

Keys, keyways, spacing, and depths

A large part of locksmithing involves learning the different types, profiles, and shapes of keys, cylinder keyways, and each manufacturer's spacing and depth specifications for their originally cut keys. Without this information, fitting keys to lock cylinders, originating keys, pinning cylinders, master keying, and the identification of keys and keyways is impossible.

TYPES OF KEYS

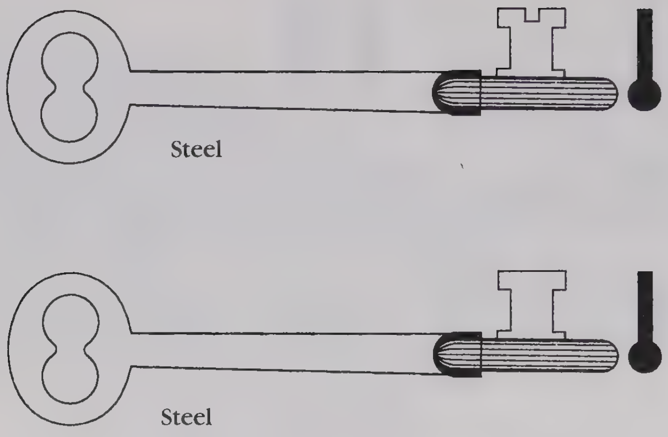
Five main types of keys are used today: barrel, bit, flat, tubular, and cylinder or paracentric. Although some high-security keys are also referred to as angularly bitted keys, in most cases these keys still are used to operate pin tumbler cylinders and therefore still fall under the category of cylinder keys.

Bit and barrel keys

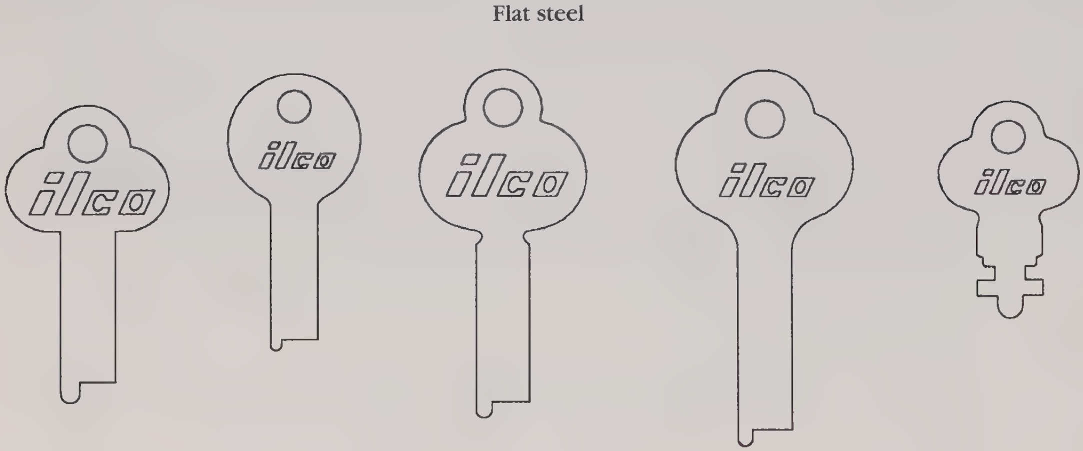
Bit and barrel keys, like the ones shown in Fig. 13-1, have been in existence for many years. These are the keys used to operate warded mortise locks. Bit keys are sometimes referred to as skeleton keys. Bit and barrel keys manufactured today are made from a variety of materials, such as malleable iron, brass, solid brass, precision cast iron, and bi-metallic. They also are sold full-blanked, or cut in any of a handful of bittings that can be used to bypass many warded locks. Barrel keys look similar to bit keys, except that they have hollow shanks. They were used frequently in furniture and cabinet locks.

Flat keys

Flat or steel keys are used mainly in lever locks, such as mailbox locks, safe deposit box locks, locker and cabinet locks, and luggage locks. They come in all sizes and are usually made of steel, although they can also be supplied in nickel-silver and brass. Figure 13-2 shows a few of the different sizes and shapes of flat steel keys.



13-1 Shows two bit keys. Accredited Lock Supply Co.



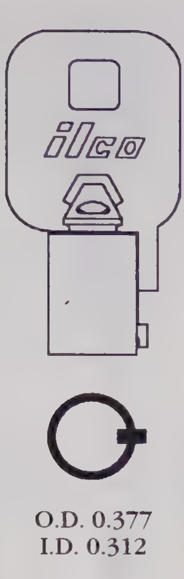
13-2 Flat steel keys, manufactured by Ilco Unican. Accredited Lock Supply Co.

Tubular keys

Tubular keys have a rounded blade and their cuts are made into the circumference ends of the blade. They are similar to cylinder keys, in the respect that they operate pin tumbler cylinders. The nib part of the key, as shown in Fig. 13-3, can be centered, offset to the left, or offset to the right.

Cylinder keys

Cylinder or paracentric keys are the most common type of keys used today. A cylinder key can be used to operate pin tumbler or wafer tumbler locks. The locksmithing term *paracentric* means of or pertaining to a keyway with one or more wards on each side projecting beyond the vertical centerline of the keyway to hin-



13-3
An ACE tubular key. Accredited Lock Supply Co.

der lock picking. In relation to keys, it means of or pertaining to a key blank made to enter such a keyway. Cylinder keys are milled along their sides, or *blade*, to fit into specific cylinder keyways. This is also done by manufacturers to prevent other manufacturers' keys from entering into their locks' keyways.

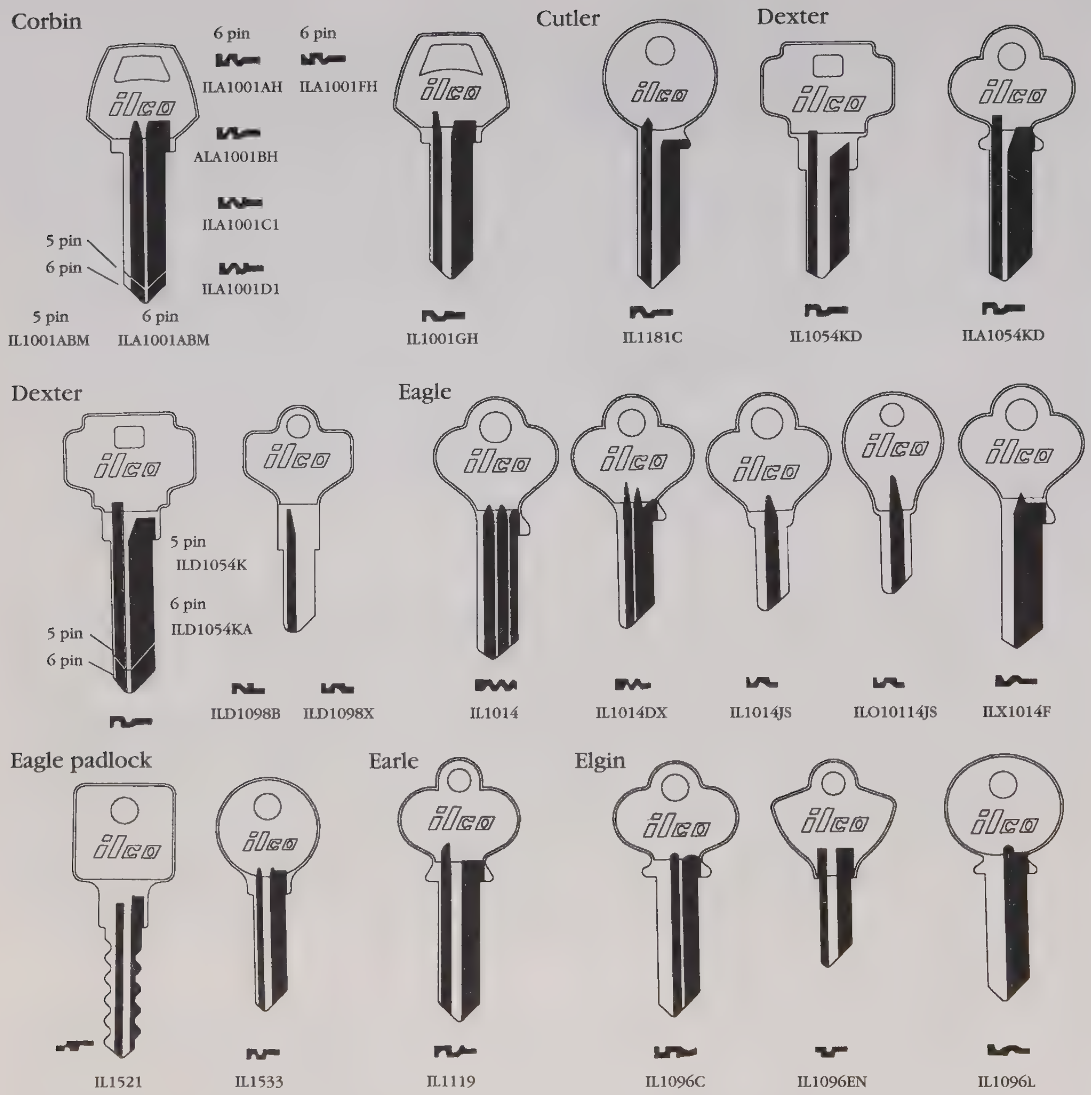
Figure 13-4 shows a group of various cylinder keys made by different manufacturers. If you look closely at the key profiles you will notice how they differ from one another. You can also understand this concept by looking at the cylinder keys on your key ring. To more fully understand the concept of paracentric keys, you will have to have a basic understanding of paracentric keys as they relate to paracentric keyways. This topic leads into the subject of keys and keyways, and shows how key control has developed from the standard paracentric keyway to sectional keying.

Lands and grooves

Certain technical terms are used to describe the paracentric conditioning of keys and keyways. These are called *lands* and *grooves*. Lands and grooves are used in machining key blanks, milling key blanks, and broaching keyways. Lands means the highest, widest, or thickest portion of a key or a keyway. Grooves refers to the portion of a key or keyway below the lands. The lands of a key match the grooves of a keyway, and the grooves of a key match the lands of a keyway. A pin-stop land is the land inside a cylinder plug that prevents the pin tumblers from falling down into the bottom of the plug. A *keyway* is the opening of a cylinder plug that allows a key or group of keys to enter into it.

As stated earlier, to thwart lock picking, supply key control (master keying), and keep other manufacturers' keys from entering into their locks, manufacturers of keys and cylinders have developed sectional keys and keyways.

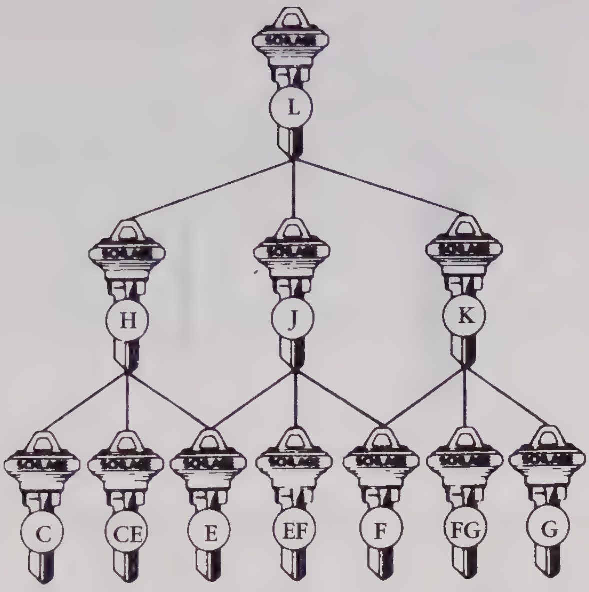
The key-system schematic in Fig. 13-5 shows one key (L) that is designed to enter into all the other keyways in this particular arrangement. At the lower level, sections C, CE, E, EF, F, FG, and G will only enter into those corresponding keyways.



13-4 A variety of pin tumbler cylinder keys. Accredited Lock Supply Co.

Key section H, however, will enter into sections C, CE, and E. Key H is a higher level key in the system, as are keys J and K. Those keys will enter into the keyways shown on the chart. Key L is the highest level key in the entire arrangement. Many manufacturers have key systems that are much more extensive and can contain hundreds of different key sections. Many of these keys and cylinders are restricted and used only in specific applications.

Key sections are used extensively in master keying. For instance, one masterkey system might provide more than 4,000 different change and master keys. By using the same exact system, but with a different keyway and a higher level master key



13-5
Sectional key array chart of Schlage keys. Schlage Lock Co.

that fits into both keyways, the system can be doubled to cover more than 8,000 locks. This can be done over and over, so long as the appropriate master keys can operate the required locks.

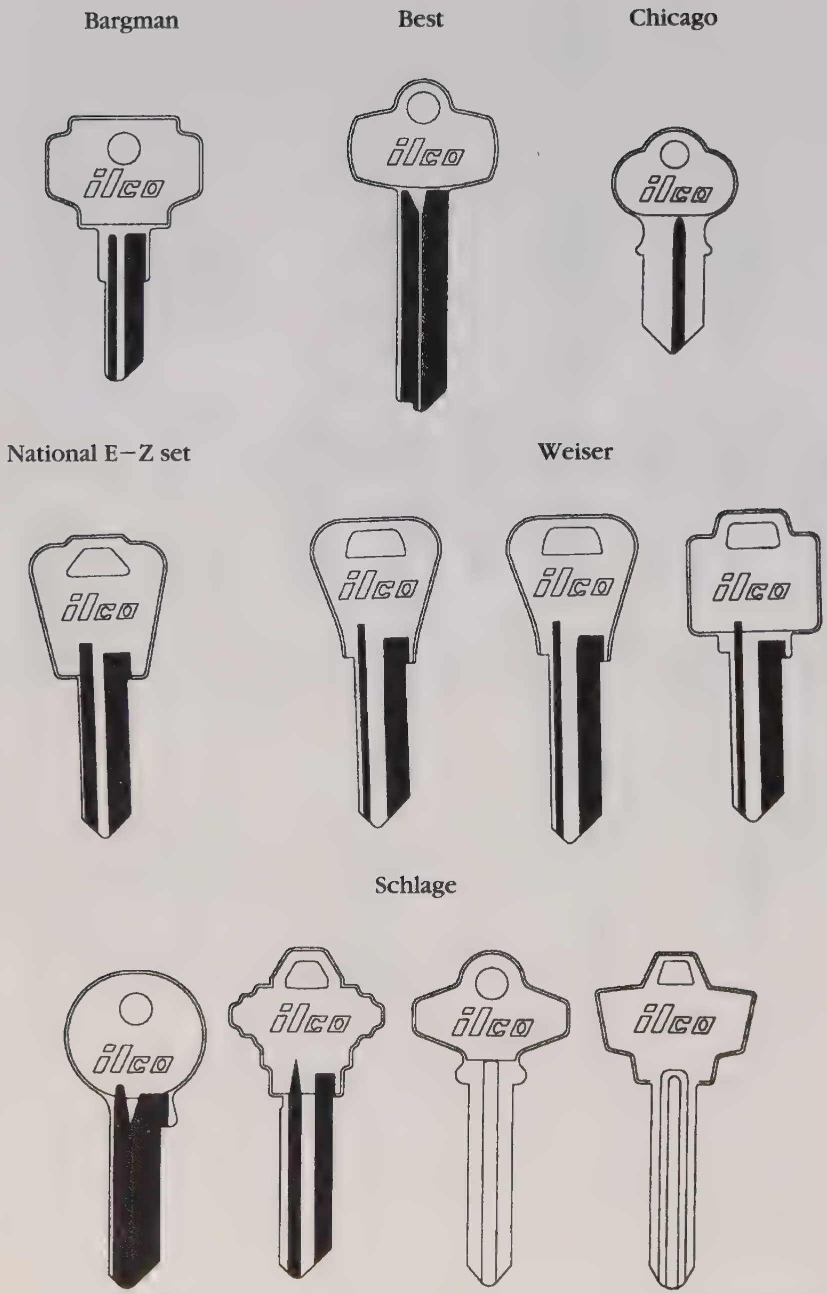
KEY IDENTIFICATION

There are basically two ways to identify the key section and manufacturer of a key. This can be done by bow identification because every key manufacturer uses a specific bow shape, or by viewing the key grooves that have been milled into the blade of the key to find the key section. Figure 13-6 shows four different key-blank bow shapes and the names of the manufacturers who designed the original key section. Become familiar with bow shapes and you can determine immediately which lock manufacturer's product a key fits.

Although bow identification tells the manufacturer, it does not tell the section the key fits. To do so, you have to be familiar with key sections and milling profiles. You can check key sections by looking at the key from the tip, or at the side of the blade. Each key manufactured today has its own particular milling (grooves, lands). After a while the identification of common key millings will become second nature to you. Figure 13-7 shows a few common key millings (under the keys) used on these manufacturer's keys.

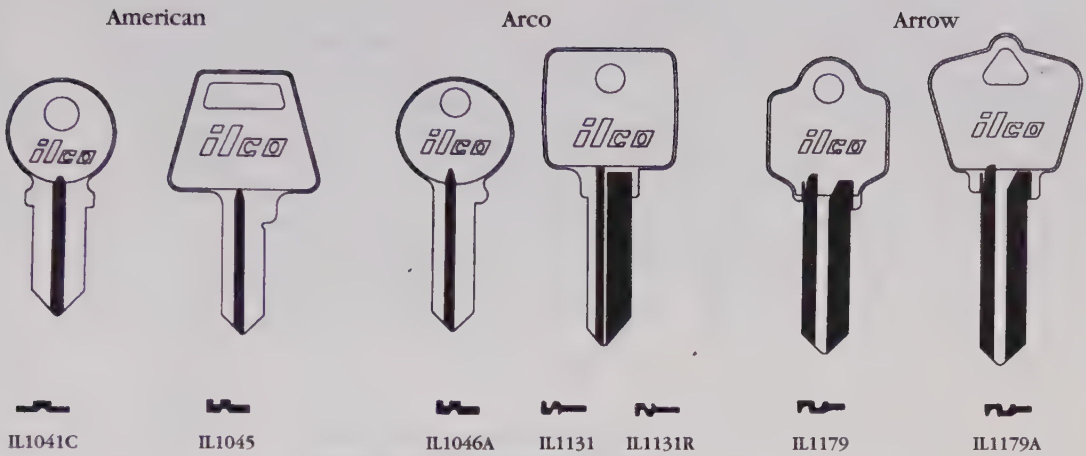
KEY CATALOGS

Key-blank directories are used extensively by locksmiths to identify keys and keyways. Without these directories it would be impossible to identify many keys because there are thousands of different ones. Most key catalogs are made by manufacturers of after-market key blanks. These catalogs are usually arranged by



13-6 Different key bow shapes by manufacturer. Accredited Lock Supply Co.

manufacturer in alphabetical order. Under each key is listed the milling profile of the key, the manufacturer's name, and cross-reference numbers of other key-blank manufacturers. Many times entire key sections will also be shown.



13-7 Shows key millings, manufacturer key blank number under each key. Accredited Lock Supply Co.

You can use the letters and numbers stamped on the key bow to identify a key. Some key-blank manufacturers stamp their key identification number on the bow, as well as the letters and numbers of the actual key section.

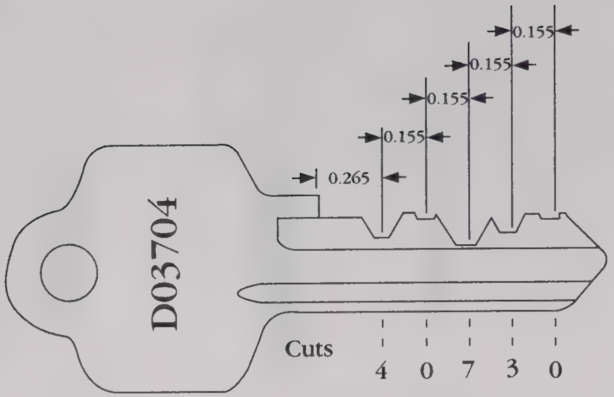
Sometimes a locksmith will have to identify a cylinder keyway. Unfortunately, the only way to do this is by memorization, trying a group of keys in the keyway, or tracing the key section by slipping master-key blanks into the keyway to narrow down the parts of a key-section tree that belong to the cylinder. You can also use key catalogs to find the milling profiles that match the keyway in question.

SPACINGS AND DEPTHS

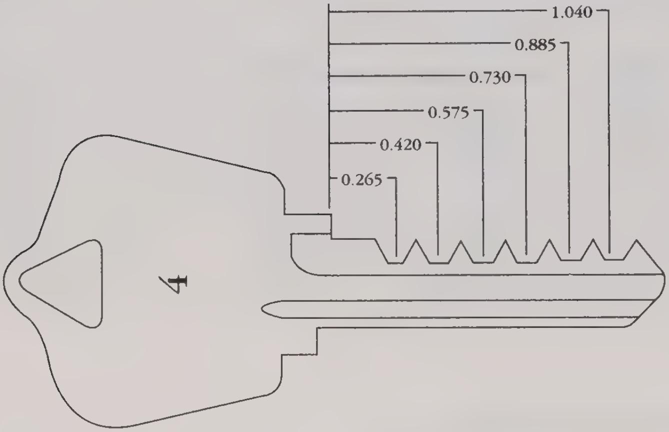
Spacing of a key refers to the dimensions from the shoulder or stop of the key to the center of the first cut and each successive cut. *Depth* refers to the measurement from the root or bottom of the key to the bottom-dead-center of each cut. Although modern key code-cutting machines use code cards to determine the proper spacing and depth for each cut, there are still some circumstances when you will have to know spacing and depth information.

Figure 13-8 shows the spacing measurements for Arrow pin tumbler keys. The picture shows that the measurement from the shoulder of the key to the center of the first cut is .265 of an inch. Each cut thereafter is .155 of an inch from center to center. The bottom part of the picture shows what those exact measurements would be for each space. If you were to cut a key by hand, with a dial caliper and file, these are the spacing measurements you would use.

The bottom of the figure also shows depth information. A #1 cut measures .301 of an inch from the bottom of the key to the flat-center-bottom of the cut. The list gives information for each depth of cut numbered 0 to 9. This information tells us that the Arrow Lock Company uses nine depths of cuts.



Direct digit as cut from tip to bow
from number on the head of key



Depth information
Uses depth increments of 0.014"

0– 0.315
1– 0.301
2– 0.287
3– 0.273
4– 0.259
5– 0.245
6– 0.231
7– 0.217
8– 0.203
9– 0.189

13-8 Depth and space dimensions for Arrow pin tumbler keys.

Effective diameter

To understand why spacing and depth information is important, you must understand the term *effective diameter*. The effective diameter is the depth of cut, plus the length of bottom pin that creates a proper shearline. For example, a #7 cut on an original Schlage key would measure 0.230 of an inch. The proper bottom pin that would be used with this cut, a #7 bottom pin, would measure 0.270 of an inch. The two measurements added together equal the effective plug diameter and should supply an effective shearline (although this measurement might or might not be the same diameter as the plug diameter itself, due to wear, machining inaccuracies, or depending on who machined the plug).

Spacing and depth information can also be used for a variety of locksmithing procedures. For instance, you can decode the key cuts on a key with a dial caliper and depth chart. This might be necessary because not every key you pick up will have its key cuts stamped on the key bow. Many service calls will require you to rekey a customer's lock. If a customer's lock is in a private residence, or is not part of a master-keyed system, then you are allowed to use a previously cut key to rekey the lock. To do this you will have to decode the cuts on the key so you know which size bottom pins to use.

DECODING KEY CUTS

Although manufacturers' key-decoding gauges can be used, locksmiths often decode cylinder keys with a dial caliper and depth chart or a key micrometer. A dial caliper measures in the thousandths of an inch (0.001). Thousandths of an inch are the units of measurement used in the locksmith industry to determine spacing dimensions, depth dimensions, and bottom and top pin dimensions. Dial calipers measure inside diameter, outside diameter, and depth. To decode a cylinder key:

1. Place the first key cut between the opened bottom gauges of the dial caliper. Softly close the gauges until they make contact with the bottom of the key blade and the flat bottom of the key cut. They should just be touching.
2. Read the measurements on the dial and blade.
3. Compare these readings to those on the depth chart for the manufacturer's key you are decoding. Repeat for each cut.

Once the key cuts are decoded you can use the corresponding bottom pins for each cut. A #1 cut will use a #1 bottom pin, a #3 cut will use a #3 bottom pin. Keep in mind, however, that due to inaccuracies in key cuts and cylinder wear, a pin that is .005 of an inch lower or higher might need to be used to effect a proper shearline.

DEPTH KEY SETS

Depth key sets are a group of keys that contain one key for each depth of cut for one manufacturer correctly spaced across the key blade from shoulder to tip. Depth keys are available from manufacturers and should be made on original manufacturer blanks only. Many beginning locksmiths, and those who do not own code-cutting equipment, use depth keys extensively to cut keys by code. They are inexpensive and the most practical solution for code cutting.

Each depth key will have the same depth of cut in each space. The reason for this is to allow the locksmith to place the proper depth of cut in any one of the three, four, five, six, or seven spaces of a key. Depth key sets can be made on code-cutting equipment, but care must be taken to use only original manufacturers' blanks and to check the accuracy of each cut before you use the set to originate keys.

14

Master keying locks

Master keying is one of the most important and technically advanced skills of the locksmith profession. It is also the one skill that can bring you a tremendous amount of profit and numerous employment opportunities. Virtually all office buildings, schools, hospitals, and public and government buildings are keyed to a master-keyed system. If you intend to work as a full-time locksmith, or even pick up some profitable part-time jobs, then learn the basics of master keying.

In this chapter you will be introduced to the basics of master keying when applied to standard pin tumbler cylinders. You will learn master-keying terminology, the various levels of master keying, and the most common methods of master keying. From there you will go on to learn how to plan and write out a simple master-keyed system for an apartment building, as well as how to decode a master-keyed system to obtain a missing or unknown top master key (TMK).

TERMINOLOGY

What is master keying? *Master keying* is the process used to enable each lock in a specific group of locks to be operated by both its own individual change key and by the master key (MK). The MK will be the only key in that specific group of locks able to open every lock in the entire group.

What is an MK? A *master key* is a key that will operate all the locks in a specific group of locks. However, for the MK to be able to open all these locks, each cylinder of each lock in the group must be **specially combinated**. Note that the words specially combinated are emphasized, and for good reason. This was done purposely to dispel the public's general misconception that a key can be made that will open almost any lock. Such keys are nonexistent except for locks that are keyed alike or in a few other particular situations, which will be explained later in this chapter. No locksmith has a key that will randomly open any car door lock, any house lock, or any other type of lock without some form of earlier cylinder preparation. All locks must be master keyed before one key will open them all. This is the process in locksmithing called master keying.

When and why is master keying used? Master keying is used to control access to specific locks in an entire group. Take for example the first floor of an apartment building. There might be 20 apartments on the first floor. Each tenant's key should not be able to open the apartment door lock of any other tenant on the floor, or that of any other apartment in the entire building for that matter. In addition, each tenant's key should not be able to open up storage rooms, or any other rooms in the building to which the landlord does not wish tenants to have access. The landlord, however, must have a key that enables him or her to open all of those locks should an emergency arise or should they have to perform maintenance services. To accomplish this, a simple master-keyed system is set up by a locksmith. Plans are drawn up, all the locks in the system are specially combinated, keys are specially cut, and then the keys are distributed.

It should be noted, though, that master keying does not supply a higher level of protection against lock picking or any other form of lock manipulation. As a matter of fact, master keying actually diminishes the security of a locking system. This is due to the increasing number of shearlines created in a master-keyed cylinder.

Before we begin our study of master keying, there are a few more master-keying terms with which you should be familiar. Knowing these terms and their meanings will help you grasp the concept of master keying.

Change key (CK)
A key in a master-keyed system that usually opens only one lock. This is the lowest level key in a master-keyed system.

Grand-master key (GMK)
A key that will operate all the locks in one or more groups of locks. Under this key there usually will be one specific MK for each group of locks. Each one of those MKs, however, will not open any lock from another group.

Great-grand-master key (GGMK)
A key that will open all the locks in all the groups, which might be separated specifically by their own GMK.

Keyed alike (KA)
One or more locks that can be operated by the same CK.

Keyed different (KD)
A group of locks that are operated by their own CK.

Single keyed different (SKD)
A lock that can only be operated by its CK. Locks keyed SKD cannot be operated by any MK in the system, including the TMK. A good example is the front door entrance lock to an apartment building.

Key interchange
An unwanted situation where one CK in a master-keyed system operates another lock by mistake.

Controlled cross keying
A situation where two CKs intentionally operate the same lock in a master-keyed system.

Uncontrolled cross keying
A situation where two or more CKs under two separate MKs operate the same cylinder.

Key section
The cross-sectional configuration of a key blade when viewed from the bow to the tip.

Multiplex master keying

A method used to expand the size of a master-keyed system by repeating the system on a different key section. The keys from one section will not operate the locks from another section, even though the key cuts and cylinder pinnings are identical. This is because of the difference in the key profiles.

Keyed common

Allows a CK to also operate another lock. This is not the same as keyed alike, since the pinnings in both locks are not identical, but combinated in such a way to allow this to happen.

MASTER KEY LEVELS

There are four levels of standard master keying. These four levels exist to enable the locksmith to plan a master-keying system as simple or as complex as required. Simple systems involve the use of one or two MKs, while a more complex system might involve multiple groups of locks that fall under the control of numerous individual MKs, GMKs, GGMKs, along with a top-level great-great-grand-master key (GGGMK).

In standard master keying, it is said that the four levels of master keying are from level two to level five. The reason master keying starts at level two, not level one, is because five levels of keying exist. While levels two to five are recognized as master keying, level one is recognized as nonmaster-keyed locks. Any level higher than level five simply adds submasters to the system.

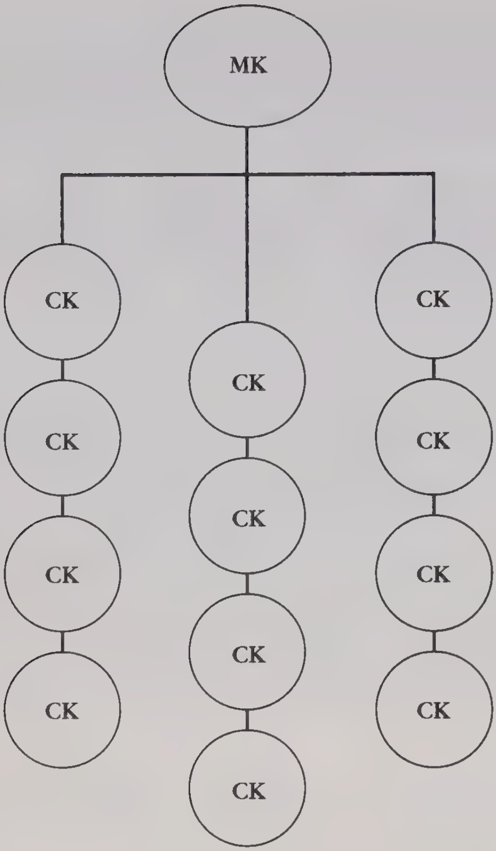
Level two

Figure 14-1 shows the arrangement of a level two master-keyed system. This is the simplest type of master-keyed system, with one or more individual groups of locks falling under the control of one MK. In addition, each lock in each group can only be operated by its individual CK as well as the MK. This type of system might be used where it is necessary to have one MK, like in an apartment building or a small office building. Although this is the simplest type of system to generate, it can still be used in situations with a large number of CKs, such as an apartment building where there are apartments on 40 floors that require only one MK.

Level three

Figure 14-2 shows how a level three master-keyed system might be arranged. In a level three system, one or more MKs would fall under the control of the top-level GMK. Each specific group of locks would operate only with their individual CKs and by their associated MK and GMK. It is important to remember that in a level three system each group of locks controlled by a separate MK can only by operated by that MK, and not by any of the other MKs. Again, all of the locks in the entire system can be operated by the top-level GMK. With this type system, each separate group of locks can be controlled individually, which prevents access from one group to the other. The only key that can give access to all the groups is the GMK.

From Fig. 14-2 you can see how master-keyed systems are expanded and made more complex simply by adding more MKs and a GMK. This type of system can be



14-1
A level two master-key system.

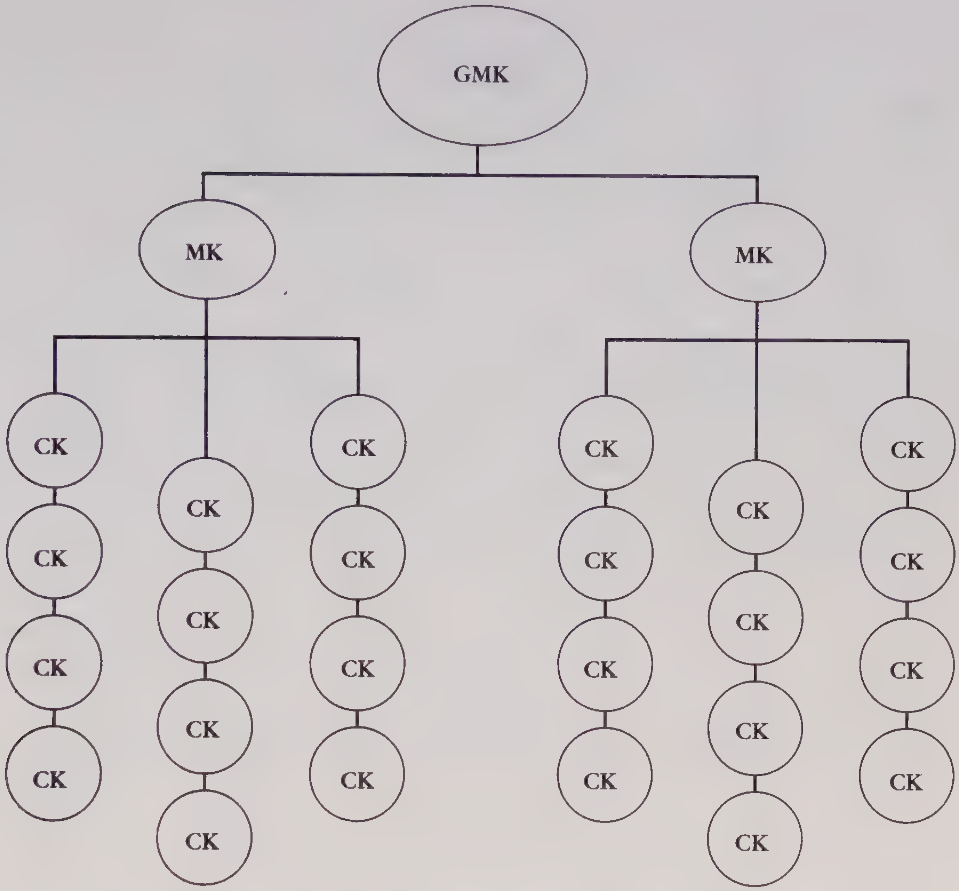
used in office buildings, apartment complexes where more than one apartment building exists, hospitals, government buildings, and other large-building complexes. By assigning different MKs to each particular group of locks, each group can be controlled individually by a separate MK. This is desirable where access to individual floors or specific areas of a building must be separately controlled.

Level four

Figure 14-3 shows a level four master-keyed system. The difference between this system and levels two and three is that control of the entire system is given to a GGMK. A level four system combines one or more GMK systems under the control of one GGMK. This allows for key control over a larger system.

Level five

Figure 14-4 shows a level five master-keyed system. The figure shows two separate GGMK systems that fall under the control of a GGGMK. This system usually is used with a large number of GGMK systems, such as very large apartment complexes, industrial complexes, public utility buildings, universities, and the like.

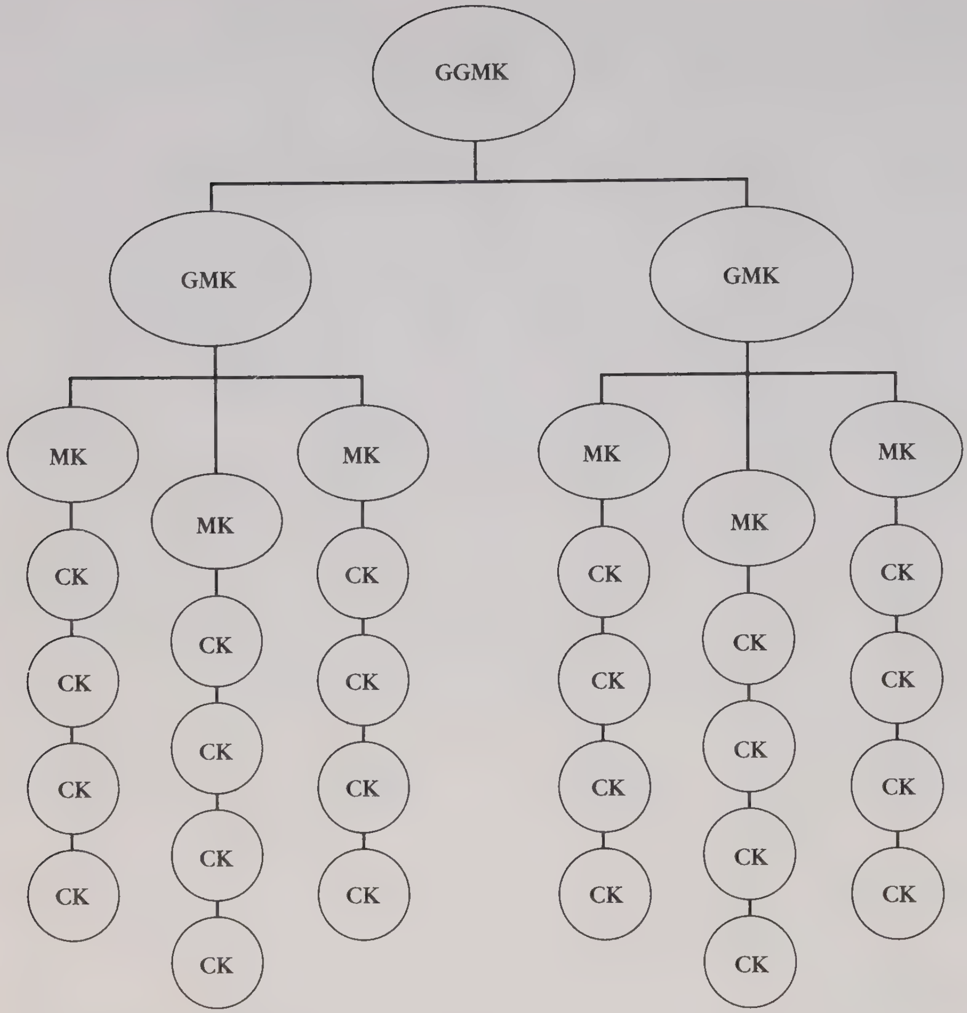


14-2 A level three master-key system.

SYMBOLS

For a locksmith to be able to properly prepare, mark, or identify the varying levels of MKs and locks in a system, he or she must have a basic knowledge of the standard key-coding symbols used in master keying. Without this knowledge, setting up a proper system, marking keys and cylinders, keeping proper records, and working with unknown systems is impossible, and might lead to chaos and the destruction of a properly prepared system. Most schools, organizations, and associations follow what is known as the standard key-coding system for master keying.

Occasionally, a locksmith might come upon an MK that has MK stamped on the key bow. Although many locksmiths make it a practice to stamp MK on the only master key in the system, this type of stamping is wrong and should be avoided at all costs. In actual practice, only GGMKs and GGGMKs should be identified as MKs using a combination of the letters G, M, and K. These keys are only present in level four and level five systems. The reasoning for this is simple. If a master-keyed system utilizes more then one MK, as shown in Fig. 14-3, then a stamping system must

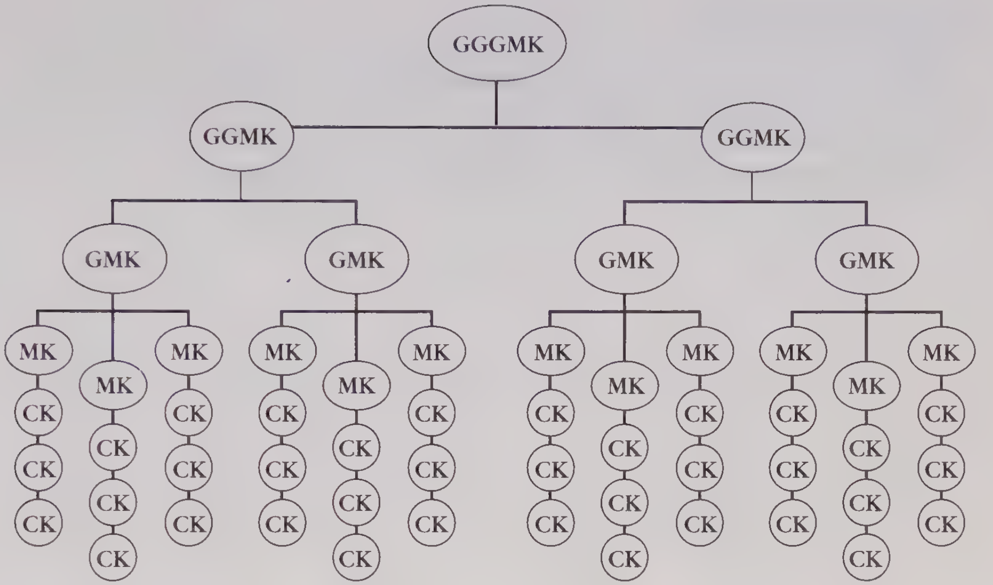


14-3 A level four master-key system.

exist that identifies each MK. You cannot stamp each master key MK because there would be no way to determine which group of locks that MK operates.

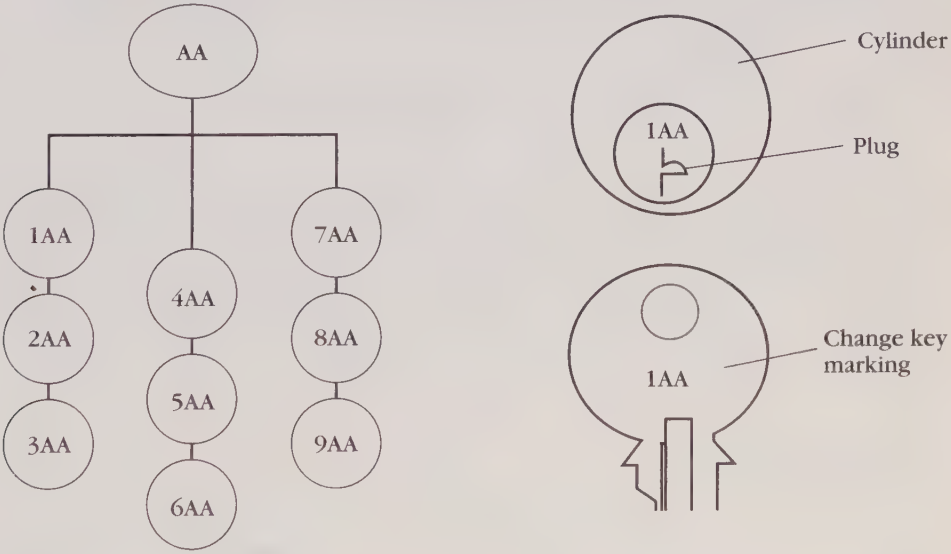
Level two symbols

Figure 14-5 shows how the MK and the CKs in a level two system are stamped. Notice also how the cylinder plugs are stamped with the exact marking of the CK that operates it. The stamping on the CK and the cylinder plug tells you two things. First, the stamping on the CK (1AA) tells you that this key will only operate the lock stamped 1AA. It also tells you that the MK that also operates this lock is stamped AA.



14-4 A level five master-key system.

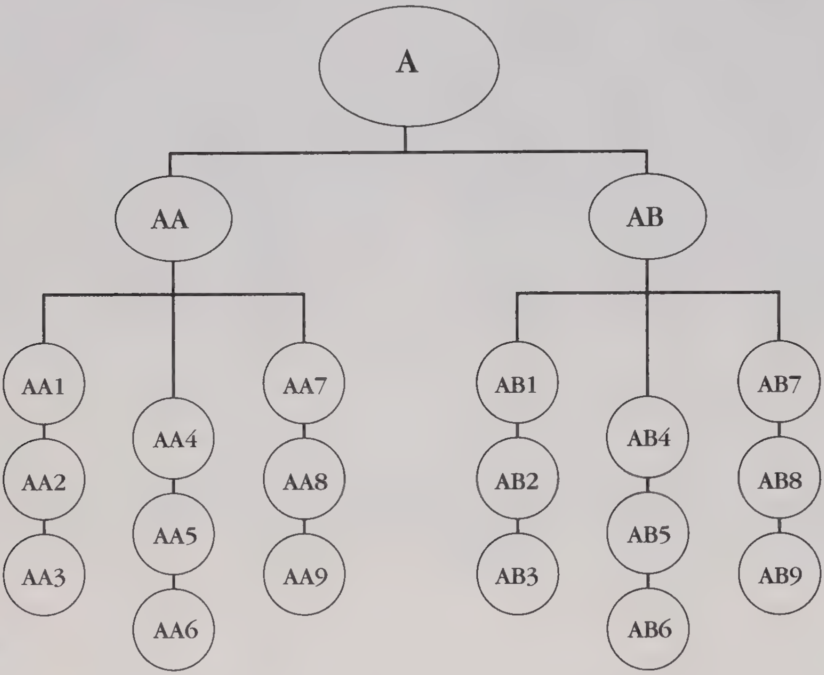
The stamp on the key can tell you about the size of a master-keyed system, or which level is being used. When you see a CK that is marked with a number followed by two letters, you know that there is only one MK in the system.



14-5 Shows a simple level two master-key system and how the change keys and cylinder plugs would be stamped.

Level three symbols

Figure 14-6 shows how the CKs, the MKs and the GMK in a level three system are stamped. A master-keyed system that uses one GMK as its TMK will use one letter to designate the GMK, usually the capital letter A. Notice that in a level three system each separate MK under the GMK is stamped progressively as AA, then AB, then AC. This tells you which MK in the system operates which group of locks.

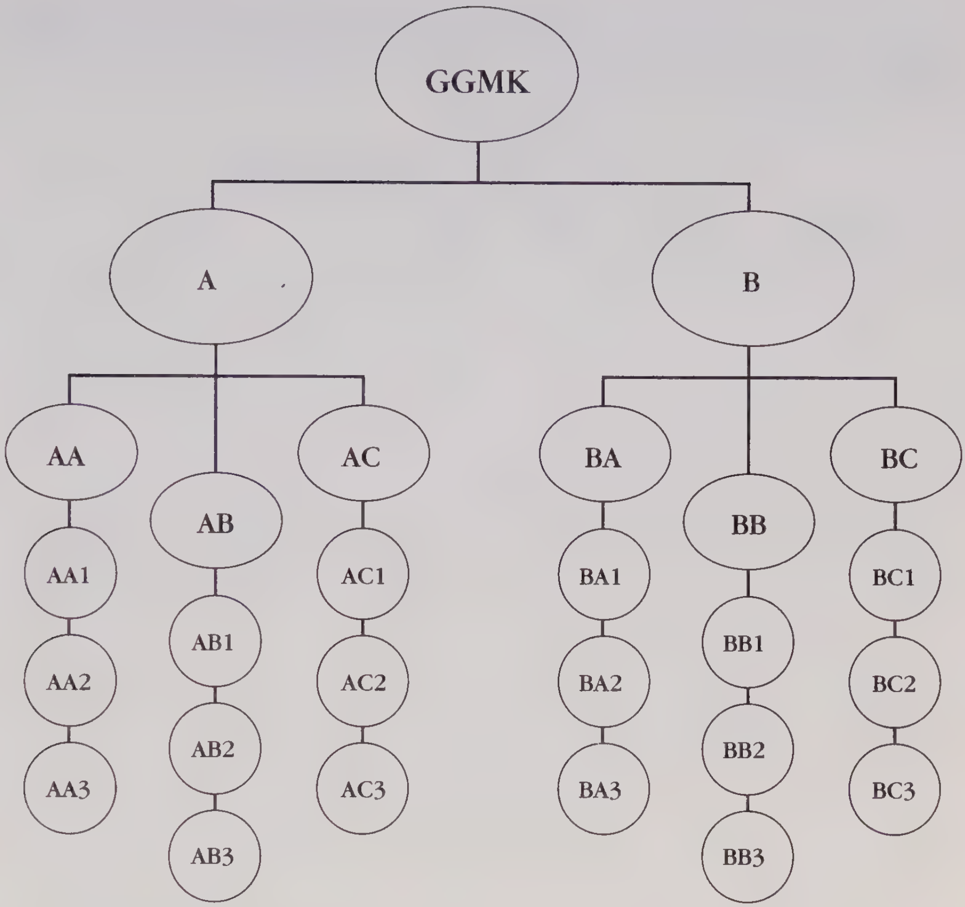


14-6 Shows level three master-key system symbol markings.

In level three systems and higher, the stampings on the CKs and cylinder plugs differ from those in a level two system or a system that uses only one MK. In a level three or GMK system, or higher, the CKs and the cylinder plugs are stamped with two letters followed by a number, as shown in Fig. 14-6. Each group of locks also follows its MK's designation stamping. All the cylinder plugs for the locks under MK AB will be stamped AB1, AB2, AB3, and so on. All the cylinder plugs for the locks under MK AC will be stamped as AC1, AC2, AC3, and so on.

Level four symbols

The stampings in a level four master-key or GGMK system are identical to those in a level three system, except for the stamping on the GGMK, which is stamped GGMK. One other difference is the addition of one or more GMKs. In level three there is only one. These keys would be marked as A, B, C, and so on, as shown in Fig. 14-7.



14-7 Shows level four master-key system symbols.

Level five symbols

In a level five master-key or GGGMK system, the key stampings change quite a bit. On the lowest level of the system, the CKs and cylinder plugs are usually marked with triple lettering, such as AAA1, AAA2, AAA3, and so on. The MKs are marked AAA, AAB, AAC, etc., the GMKs are marked as AA, AB, AC, and so on. You should realize that the higher the system level, the more letters will come before a number. The change in the symbol-marking pattern in a level five system or higher is dependent on the hypothesis of the lesson or method that the student has been taught. It is still acceptable, however, to use stampings of only two letters before a number in levels three and higher, if that is what the person designing the system prefers.

Symbol reference table

One of the most difficult things for a beginning locksmith to do is to decipher the symbols and stampings used in master-keyed systems. For this reason, I have included a symbol reference table that can be used to quickly interpret key stampings (Table 14-1). You can also use this table to determine which markings should go on which keys.

Table 14-1
Master keying symbol reference table

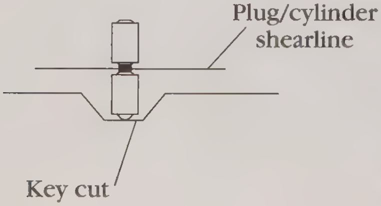
MK level	GGGMK	GGMK	GMK	MK	CK
II	-	-	-	AA	1AA, 2AA
III	-	-	A, B	AA, AB	AA1, AA2
IV	-	GGMK	A, B	AA, AB	AA1, AA2
V	GGGMK	A, B	AA, BB	AAA, AAB	AAA1, AAA2

THE MASTER-KEYED CYLINDER

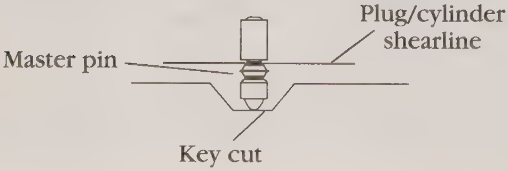
A master-keyed cylinder is one that possesses more than one shearline. As a result the cylinder can be operated by more than one key. An extra shearline is created by the addition of an extra wafer, which is placed in a plug chamber between the bottom pin and the top or driver pin. This extra tumbler is called a *master pin* or a *master wafer.*

Figure 14-8 shows a cylinder with one bottom pin and one top pin placed in the first chamber of a plug. When the properly cut key is inserted, the cut will raise the top of the bottom pin flush with the division between the plug and the shell and create a shearline. When only one bottom pin and one top pin exists in each chamber, only one key will operate it (nonmaster-keyed cylinder).

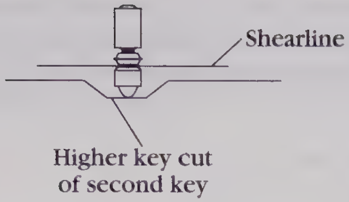
Figure 14-9 shows the same plug with only the first chamber pinned, but this time with an added master pin. Because of the master pin in this chamber, two shearlines now exist. One is created when the top of the master pin (which is sitting above the bottom pin) lays flush with the division between the plug and the shell (as shown in Fig. 14-9). The other shearline is created when the bottom of the master pin sits flush with the division between the plug and the shell, as shown in Fig. 14-10. As a result, an additional key can be cut to operate this cylinder. Because two



14-8
One chamber of a pin tumbler cylinder with only a bottom pin and a top (driver pin). Also shows how the key cut causes the bottom pin to flush out at the shearline.



14-9
A key cut causing the bottom pin and master pin to sit below the shearline.



14-10
A different key cut causing the master pin to flush out above the shearline.

keys now operate this cylinder, as shown in this simplified example, one key is known as the CK and the other key is known as the MK. The MK will always be the key that operates the second shearline.

Creating multiple shearlines

In our last example, only two shearlines were created because only one chamber was pinned with a bottom, a master, and a top pin. To create additional shearlines, and allow more than two keys to operate the cylinder, more than one chamber can be master keyed. This will create an additional 16 extra keys that might possibly operate this cylinder. To find those extra 16 theoretical shearlines, and understand how they exist, we use what is known as a bitting list.

Creating a bitting list

A bitting list shows all the possible keying combinations that exist in a cylinder or an entire system. The numbers used in the bitting list correspond to the lock manufacturer's coding system for key-cut depths. For example, the Schlage Lock Company uses coded key-cut depths numbered 0 through 9.

In our first example, two keys were cut to operate this cylinder due to the fact that only two coded pins were used, of which the sizes were unknown. In actual master-keying practice, however, a bitting list is drawn up to help determine the possible key cuts on the keys that are to be used.

In the first example, if there is only one pin in one chamber the bitting list would help determine how many keys could possibly be cut to operate the #1 master-keyed chamber. Using Schlage's key coding system we can record these numbers by using increments of twos known as a two-step progression. We use increments of twos to eliminate having to use a master pin that is only .015 of an inch in thickness, which might wear out quickly and possibly cause the plug and the cylinder to jam. The bitting list is drawn up in the following way using Schlage's key cut depths 0 through 9:

Key bitting list

0	1
2	3
4	5
6	7
8	9

Notice that there are two columns, one odd and one even. In master keying there are always alternate adjacent-keyed chambers between odd and even, which eliminate any danger of uncontrolled cross keying.

The first step is to choose the bitting for the MK. In this instance, we will choose the 0 bitting. Always choose the shallowest possible bitting for the master-key cut. This prevents a CK from being cut down to the same depth as the MK.

Now that we have our master-key bitting (0), the CK bittings for this chamber can be written down:

MK = 0
#1 CK = 2
#2 CK = 4
#3 CK = 6
#4 CK = 8

Notice that there are four possible CKs to which the first chamber in this cylinder might be pinned. If an odd number for the MK was chosen, say a #1 cut, then the four possible CKs would be:

MK = 1
#1 CK = 3
#2 CK = 5
#3 CK = 7
#4 CK = 9

If you place a master pin in one chamber, you have four possible pinning combinations you can use in the first chamber, or you can pin up to four different cylinders that will operate with this one MK. Each of the four cylinders will also operate under their own CK. The following list shows how to figure which bottom pin sizes and master pin sizes to use. The bottom pin size will always match the shallowest of the two key cuts, the master pin size will be the difference between the CK cut and the bottom pin size.

Cylinder #1
MK cut = 1
CK cut = 3
bottom pin = 1
master pin = 2

Cylinder #2
MK cut = 1
CK cut = 5
bottom pin = 1
master pin = 4

Cylinder #3
MK cut = 1
CK cut = 7
bottom pin = 1
master pin = 6

Cylinder #4
MK cut = 1
CK cut = 9
bottom pin = 1
master pin = 8

In actual master keying, the #4 CK would not be used because there is a difference of more than 7 between the CK and the MK. This is what is known as Maximum Adjacent Cut Specification (MACS), which is discussed elsewhere in this book. Schlage keys can never have more than a seven-cut depth difference between cuts. If a #9 cut was placed next to a #1 cut, the angle of the deeper #9 cut would cancel out the #1 cut. When you check for usable bittings, always eliminate those key-cut combinations between two chambers on CKs that exceed the MACS specifications.

MASTER KEYING MULTIPLE CHAMBERS

Master keying more than one chamber will supply more than four theoretical CK combinations. Master keying two chambers will supply you with 16 possible bittings. The list below shows how:

#1 Chamber	#2 Chamber
MK = 0	MK = 1
CK = 2	CK = 3
CK = 4	CK = 5
CK = 6	CK = 7
CK = 8	CK = 9

Using this list, the possible bittings are:

23	43	63	83
25	45	65	85
27	47	67	87
29	49	69	89

These bittings were derived by progressing the first number in the first column or chamber with each number in the second column, or chamber. Then the second number in the first column was progressed with each number in the second column, and so on. From this list you can determine that by master keying two chambers you will wind up with 16 theoretical CKs, to which 16 different cylinders might be pinned.

In actual master keying, however, the number of chambers master keyed is determined by the number of CKs needed. For example, if only four different CKs are required (four locks operating under one MK), then only one chamber needs to be master keyed. If five or more CKs are required (up to 16), then two or even possibly three chambers will have to be master keyed (three chambers might be needed to make up for the bittings that would be eliminated due to MACS). See the list below to determine how many CKs can be derived for a master-keyed system using a two-step progression for a six-chambered cylinder.

2 chambers master-keyed-4 ~ 4 = 16
3 chambers master-keyed-4 ~ 4 ~ 4 = 64
4 chambers master-keyed-4 ~ 4 ~ 4 ~ 4 = 256
5 chambers master-keyed-4 ~ 4 ~ 4 ~ 4 ~ 4 = 1,024
6 chambers master-keyed-4 ~ 4 ~ 4 ~ 4 ~ 4 ~ 4 = 4,096

With this system, 4,096 cylinders can be master keyed. All of these cylinders will operate only by their own CK, and also by the MK. The MK will theoretically be able to open all 4,096 locks!

MASTER-KEYING METHODS

There are a number of master-keying methods that can be employed. In our previous bitting-list examples I wrote out a basic bitting list for two master-keyed chambers using the standard two-step progression method. With this method, bitting numbers are listed separately in columns of odd and even numbers and in increments of twos—the most popular arrangement amongst locksmiths.

One lock manufacturer, Kwikset, uses increments between pin sizes of 0.023 of an inch compared to Schlage's increment difference of 0.015 of an inch. Because of the difference in pin thickness from one cut depth to the next, a bitting list can be drawn up that uses every cut depth in one column. This is what is known as single-increment progression. For example, the following bitting list shows a master-keyed system for a large group of Kwikset locks using single-increment progression.

master key = 2 3 5 4 1 3
3 4 6 5 2 4
4 5 1 6 3 5
5 6 2 1 4 6
6 1 3 2 5 1
1 2 4 3 6 2

Single-increment progression yields a master-keyed system with a much larger number of CKs. For instance, a system that progresses all six columns of a key-bitting list using single-increment progression will supply the system with up to 15,625 theoretical bittings. In actual practice, however, some of those bittings will have to be discarded. For example, in single-step progression any bitting that contains the same number in all the columns should not be used, nor should any that are only one-step away from each other in every column. For example, a bitting of 444444 should not be used, nor should a bitting of 343434, or even a bitting that has three identical cut depths in a row like 231333.

ROTATING CONSTANT PROGRESSION

The rotating constant progression of master keying is used when a larger number of CKs are required to operate under one MK. The rotating constant progression is also known as the moveable constant or hold and vary progression, and is usually used in only level two master-keyed systems.

The column progression used in rotating constant progression is much different than that used in standard single- and two-step progression. In rotating constant progression each column that is not being progressed uses the bittings of the MK. For example, the bitting list below shows how the bitting list is written using standard two-step progression with one column progression.

column 1 2 3 4 5
master 5 4 1 2 3
7 6 3 4 5
9 8 5 6 7
1 0 7 8 9
3 2 9 0 1

The following example shows how column #1 would be progressed. Because only one column is being progressed at a time, only that column would use the CK bitting numbers. All the other column numbers would use the bittings of the MK. For example, the progression bittings for column #1 would be written as follows:

7 4 1 2 3
9 4 1 2 3
1 4 1 2 3
3 4 1 2 3

Column #2 of this bitting list would be written as:

5 **6** 1 2 3
5 **8** 1 2 3
5 **0** 1 2 3
5 **2** 1 2 3

The remaining three columns would be written as follows:

Column #3	Column #4	Column #5
5 4 **3** 2 3	5 4 1 **4** 3	5 4 1 2 **5**
5 4 **5** 2 3	5 4 1 **6** 3	5 4 1 2 **7**
5 4 **7** 2 3	5 4 1 **8** 3	5 4 1 2 **9**
5 4 **9** 2 3	5 4 1 **0** 3	5 4 1 2 **0**

Note: In the progressions shown, only the column that is being progressed changes numbers (bittings). All the other columns remain constant with the bittings of the MK. Now you can see why this progression usually is suitable only when the system requires one MK. By progressing only one column at a time, we were able to come up with 20 CKs.

The rotating constant progression method allows more than one column to be progressed at a time. This is how this type system is able to supply more CKs than any other type system. Progressing two columns at a time will supply 160 CKs.

The sequence of column progression must be recorded when you use the rotating constant progression method. This is done with what is known as a column progression sequence chart. This is the only way to keep track of how many and how the columns are progressed. A one-column progression sequence chart would appear as the following:

Columns	1	2	3	4	5
Step 1	X				
Step 2		X			
Step 3			X		
Step 4				X	
Step 5					X

This sequence chart shows that column #1 is progressed first, then column #2, and so on. This sequence chart could also have been written to show a different kind of column progression sequence like this:

Columns	1	2	3	4	5
Step 1		X			
Step 2	X				
Step 3			X		
Step 4				X	
Step 5					X

Using this sequence chart, column #2 would be progressed first, column #1 would be progressed second, column #3 would be progressed third, and so on. The sequence chart for two-column progression would be written as follows:

Column	1	2	3	4	5
Step 1	X	X			
Step 2	X		X		
Step 3	X			X	
Step 4	X				X

This chart shows that columns #1 and #2 would be progressed together first, columns #1 and #3 would be progressed second, and so on.

The previous two-column progression sequence chart shows how the original bitting list with the master-key bitting of 54123 would be progressed. The chart shows that you would first progress column #1 with column #2. You would then progress the bittings in the following manner. The first bitting in column #1 would be progressed with each bitting in column #2. Then the second bitting in column #1 would be progressed with each bitting in column #2, and so on, until each bitting in column #1 has been progressed with all the bittings in column #2. The CK bittings for step #1 would be written as follows:

76123 **96**123 **16**123 **36**123
78123 **98**123 **18**123 **38**123
70123 **90**123 **10**123 **30**123
72123 **92**123 **12**123 **32**123

Step #1 yields 16 CKs. Step #2 yields 16 more CKs when progressing column #1 with column #3. Step #3 yields 16 more, as does Step #4. The total number of CKs yielded using five steps is 64 theoretical CKs. Compare this to standard two-step progression, which will yield only 16 CKs when you master key two chambers. (There is a lot more to learn about the rotating constant progression method of master keying. To learn more, look for the list of master-keying books at the end of this chapter.)

CREATING A SIMPLE MASTER-KEYED SYSTEM

For simplicity sake, the standard two-step progression method of master keying has been used to lay out a simple level two master-keyed system for a small apartment building. This example should give you an idea of how to set up the most basic systems.

In this example you are being asked to set up a master-keyed system for an apartment building that has six floors, with five apartments on each floor. Each tenant requires one key for their apartment and one additional key for the front entrance door. The building landlord, who is also the superintendent, requires one key that will open his or her apartment door and the other 29 rented apartments. To satisfy these requirements, you will first have to determine how many CKs are needed. Remember to allow extra bittings for theoretical CKs that must be eliminated and for additional CKs for future use, such as when a tenant moves out and the lock must be rekeyed to operate under the present system.

With these requirements in mind, you decide to set up a level two master-keyed system that will supply at least 64 CKs and involve the master keying of three chambers. Although the initial purchase only requires 30 CKs, 64 CKs will allow an additional 34 theoretical extra bittings. This will make up for bittings that must be eliminated, and also for rekeying that will be needed as tenants move in and out during the next few years.

Step #1 will be to select a master-key bitting for the system. You have selected the bitting of **14302** for your MK. Step #2 is to write down the master-key bitting and then below it your CK bitting list, which is also known as a key-bitting array (KBA). Notice that a 0 cut was used in your MK to prevent any of the CKs from being filed down to match the MK. The KBA would be written as follows.

MK = 1 4 3 0 2
3 6 5 2 4
5 8 7 4 6
7 0 9 6 8
9 2 1 8 0

The next step would be to write down all your CK bittings. Because you are only supplying 64 CKs, you need only master key three chambers. Therefore you will only be progressing three columns. To avoid confusion, you can rewrite the bitting list by eliminating the columns that will not be progressed. The bitting list is now written as:

column = 1 2 3 4 5
MK = 1 4 3 0 2
5 2 4
7 4 6
9 6 8
1 8 0

As this example shows, you have decided to master key the last three chambers. You can now begin to progress each column with the other two. To start, progress the first bitting in column #4 with each bitting in column #5. When those possible 4 bittings are exhausted, progress the second bitting in column #4 with all the bittings in column #5. Continue progressing left to right until all the possible combinations for the last two columns have been exhausted. The 16 possible bittings are:

1 4 5 2 **4** 1 4 5 **4 4** 1 4 5 **6 4** 1 4 5 **8 4**
1 4 5 2 **6** 1 4 5 4 **6** 1 4 5 6 **6** 1 4 5 8 **6**
1 4 5 2 **8** 1 4 5 4 **8** 1 4 5 6 **8** 1 4 5 8 **8**
1 4 5 2 **0** 1 4 5 4 **0** 1 4 5 6 **0** 1 4 5 8 0

After progressing all the bittings in column #4 with all the bittings in column #5 you end up with 16 theoretical bittings. Notice that bitting 14580 has been staked out. This bitting will be eliminated due to the MACS. Because all these possible bittings are now exhausted, progress all the bittings in column #3 with all the bittings in columns #4 & #5.

Progress all the bittings in column #3 by taking the second bitting in column #3 and then progressing it with all the bittings in columns #4 & 5. The second bitting—

#7—will be progressed with the first bitting in column #4 and the first bitting in column #5. It will then be progressed again with the first bitting in column #4 and then each subsequent bitting in column #5. The following shows how this progression sequence would be written. In this group of bittings, the first two numbers (1 and 4) have been eliminated; it is not necessary to print out those numbers that remain constants.

14724	14744	14764	14784
726	746	766	786
728	748	768	788
720	740	760	780

After progressing the second number in the third column with all possible bittings in the fourth and fifth columns, progress the third bitting in the third column (#9) with the fourth and fifth column bittings. All the remaining 32 bittings are also shown.

14924	14944	14964	14984
926	946	966	986
928	948	968	988
920	940	960	980

14124	14144	14164	14184
126	146	166	186
128	148	168	188
120	140	160	180

These four bitting lists give the 64 theoretical bittings, although it has only actually supplied us with 60 useable bittings (due to the 4 that have been eliminated due to the MACS). These are the actual 60 key cuts that will be used.

The next step after writing down the key bittings is to write a pinning chart. A pinning chart tells you which size bottom pins to use in each chamber and also which size master pins must be used. When recording an actual master key system, however, proper records must be kept of each lock in the system, what its lock cylinder was keyed to, and how it was pinned. This is done by coding (stamping letters and numbers) on each key and the cylinder which matches it. This can be done easily by assigning the appropriate letter and number on the change key and pinning charts. The following shows an example of how this is done.

1AA	14524	5AA	14544	9AA	14564	13AA	14584
2AA	14526	6AA	14546	10AA	14566	14AA	14586
3AA	14528	7AA	14548	11AA	14568	15AA	14588
4AA	14520	8AA	14540	12AA	14560	16AA	14580

Pinning chart

Master key	14302	Master key	14302
1AA	*14524*	*5AA*	*14544*

Bottom pin	1 4 3 0 2	Bottom pin	1 4 3 0 2
Master pin	- - 2 2 2	Master pin	- - 2 4 2

Decoding the unknown master key

There may be times as a locksmith when you will be called upon to decode an existing master key system for the purpose of servicing the system. Buildings are often sold and come under the control of new management. Unfortunately, many times when this happens the existing master key records have been lost, taken with the last tenant or locksmith, or are simply not available.

To easily find the top master key (TMK) to a system, you will need to have one change key to the system and the lock cylinder that matches it. Follow these steps:

1. Decode the cut on the change key.
   Change key reads: 1 4 5 2 4
2. Decode the bottom pins.
   Bottom pins read: 1 4 3 0 2
3. Decode the master pins.
   Master pins read: - - 2 2 2

You know from the previous lessons that by putting a master pin in only one chamber of a five-chamber cylinder, creates two bittings. One master pin in two chambers equals four bittings, one master pin in three chambers equals 8 bittings. In this example, because there are only three master pins, we know that 8 possible bittings exist, one of which will be the TMK.

Instead of writing out each possible bitting, however, there is a shorter method. Follow this formula to decode the master key:

1. Write down the change key bitting.
2. Write below the change key bitting the numbers that represent the sizes of the bottom pins.
3. Write down the total of the bottom pins added to the master pins.

Column # *1 2 3 4 5*
Change key = 1 4 **5 2 4**
Bottom pins = 1 4 **3 0 2**
BP's + MP's = 1 4 **5 2 4**

There are now three rows of numbers. Remember that no bitting used in a master key can be used in the change key in the same position, or rather, in the same position where the chamber has been master keyed. Therefore, cancel out those numbers in the last two rows that match the numbers of the change key bittings. The remaining numbers are the bittings of the top master key.

Column # *1 2 3 4 5*
Change key = 1 4 **5 2 4**
Bottom pins = 1 4 **3 0 2**
BP's + MP's = 1 4 5 2 4

Top master key = 1 4 3 0 2

Thus far, I have covered only the very basics of master keying. There is a tremendous amount more to learn about master keying, but unfortunately to put all that information in this book would require a few more hundred pages. If you want to learn more about master keying, purchase technical manuals and books that deal with the subject in-depth. One such series of books, which is available through the Locksmith Publishing Company, is the *Manual of Master Keying Book One—Basic*, and the *Manual of Master Keying Book Two—Advanced*. Both books are written by G. L. "Gerry" Finch, renowned for his expertise on this subject.

15

Interchangeable cores

An interchangeable core (IC) is a key-removable core or cylinder assembly that can be used in all or most of the core manufacturer's product line. No tools other than the control key are required to remove the core. Interchangeable cores make it possible to rekey a lock in seconds. In minutes, an entire floor of lock cylinders can be changed. Office buildings, government offices, hospitals, schools, stores, and even some apartment complexes now use interchangeable cores exclusively to satisfy all their keying needs. All locksmiths should have a general knowledge of the workings and servicing procedures for ICs. This chapter will give information compatible with ICs manufactured by Best, Falcon, Arrow, Eagle, and Lockwood.

DEFINITIONS

There are a number of IC definitions with which you should be familiar. Understanding these terms will help you more readily grasp the concept of ICs.

Control key
The key that is used to remove an IC assembly from the lock.

Core assembly
The entire IC assembly that includes the shell, sleeve, plug, and all top, bottom, master, and control pins and springs, etc.

Housing
The housing is the same as the shell in a standard pin tumbler cylinder. Housing refers to mortise lock shells in ICs. In key-in-knob (KIK) locks, the housing is the knob.

Sleeve
The sleeve is the part that contains the plug. It also sits between the plug and the housing and contains the locking lug.

Locking lug
The part connected to the sleeve that keeps the entire core assembly from being removed.

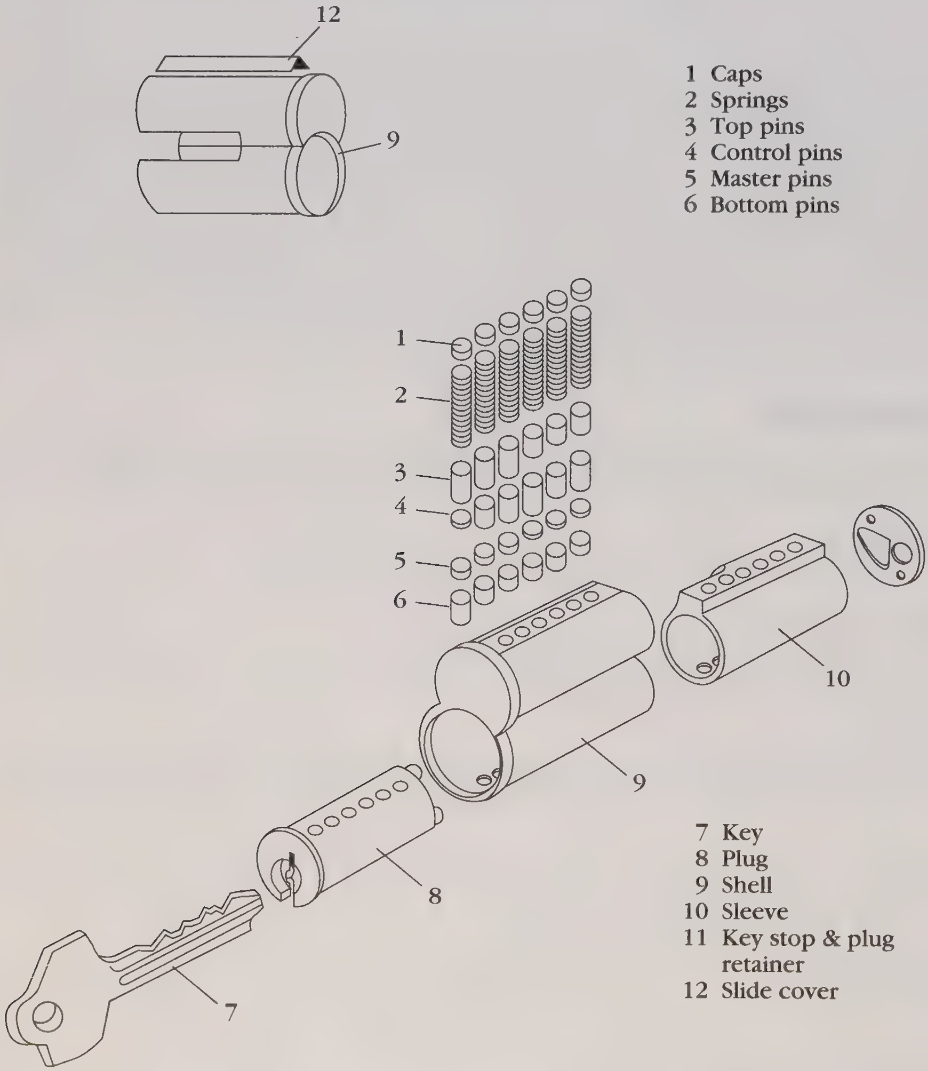
Control shearline
The second shearline that is created between the shell and the sleeve.

Control pins
The pins that create the control shearline. They sit between the top pins and the bottom and master pins.

Pin stack
The coded length of pins that must be present in an IC.

BASIC OPERATION

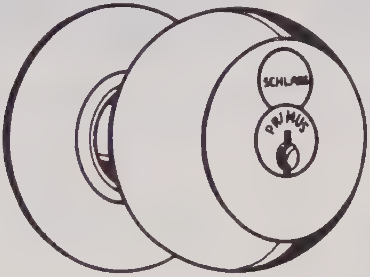
Figure 15-1 shows the parts of an IC. ICs have been around since the late 1930s, although it hasn't been until the last few decades that they have begun to be used



15-1 This exploded view shows all the parts of a typical interchangeable core. G.L. "Gerry" Finch more often. ICs are used for the sole purpose of being able to quickly rekey a lock without removing the lock, knob, or other parts from the door. Previously keyed ICs are kept on hand and used for this purpose. It would be defeative to rekey an IC in the field since that would defeat the purpose of ICs. Almost every locksmith who works with ICs keeps dozens of keyed ICs on hand to be used on a moment's notice. Most of these ICs are part of and integrated into an existing IC master-keyed system.

CONSTRUCTION

In KIK lock designs, the housing of the IC is the same as the shell in a standard pin tumbler cylinder (Fig. 15-2). An IC mortised housing can be recognized immediately by its figure-eight-shaped cutout. It is this cutout that accepts the figure-eight-shaped core assembly. Another main difference between a figure-eight-shaped mortised IC housing and a standard pin tumbler cylinder shell is the fact that the cam is part of the housing, not the plug. This can be recognized (with the assembly removed) by the cam's two prongs that fit into the back of the core plug. In a mortise cylinder, the shell itself is the housing for the core assembly.

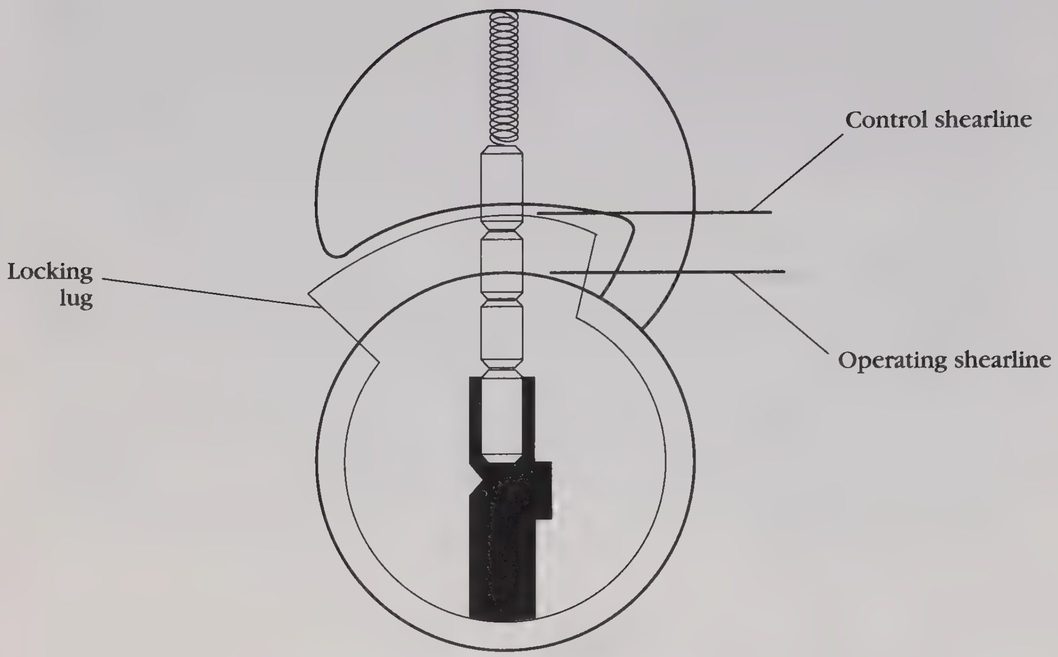


15-2
An interchangeable core housing, in a key-in-knob lock.
Schlage Lock Co.

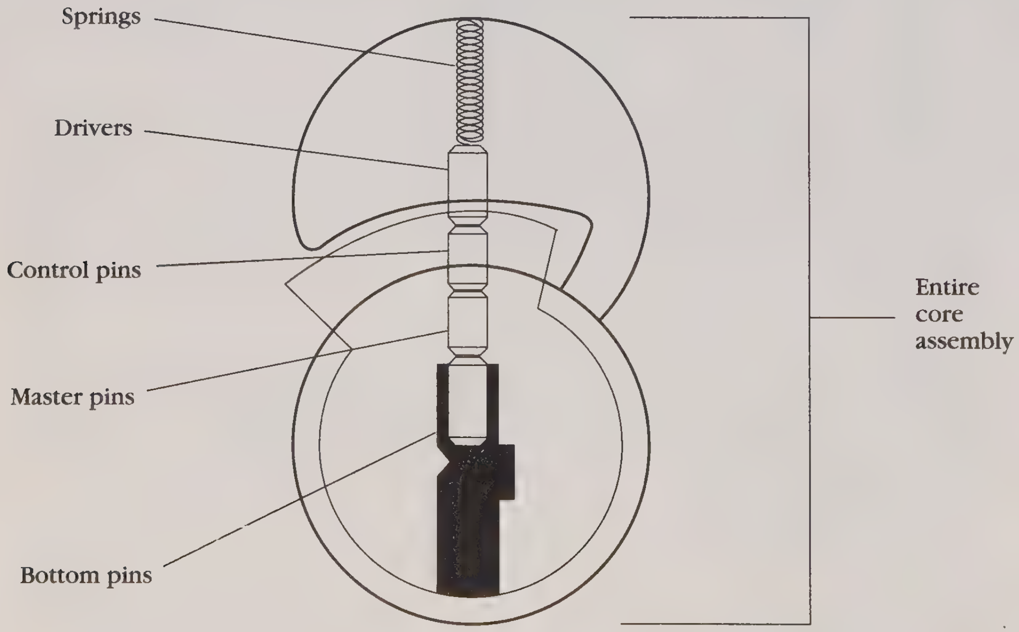
Figures 15-3 and 15-4 show an anterior see-through view of how the pins and the locking lug of the sleeve sit inside the core assembly when there is no key inserted. Notice how the locking lug protrudes past the core. This lug prevents the entire core from being removed from the housing. Also notice the two shearlines that are blocked. One is the operating shearline and one is the control shearline. When there is no key inserted into the plug, both of these shearlines remain blocked.

Figure 15-5 shows the cleared operating shearline and the plug rotated in the normal manner. In an IC, the operating shearline is between the sleeve and the plug. Both bottom pins and master pins create this shearline when either the change key (CK) or the master key (MK) is inserted. When either of these keys are used, the core cannot be removed. The core can only be removed with the control key that creates the control shearline, as shown in Fig. 15-6.

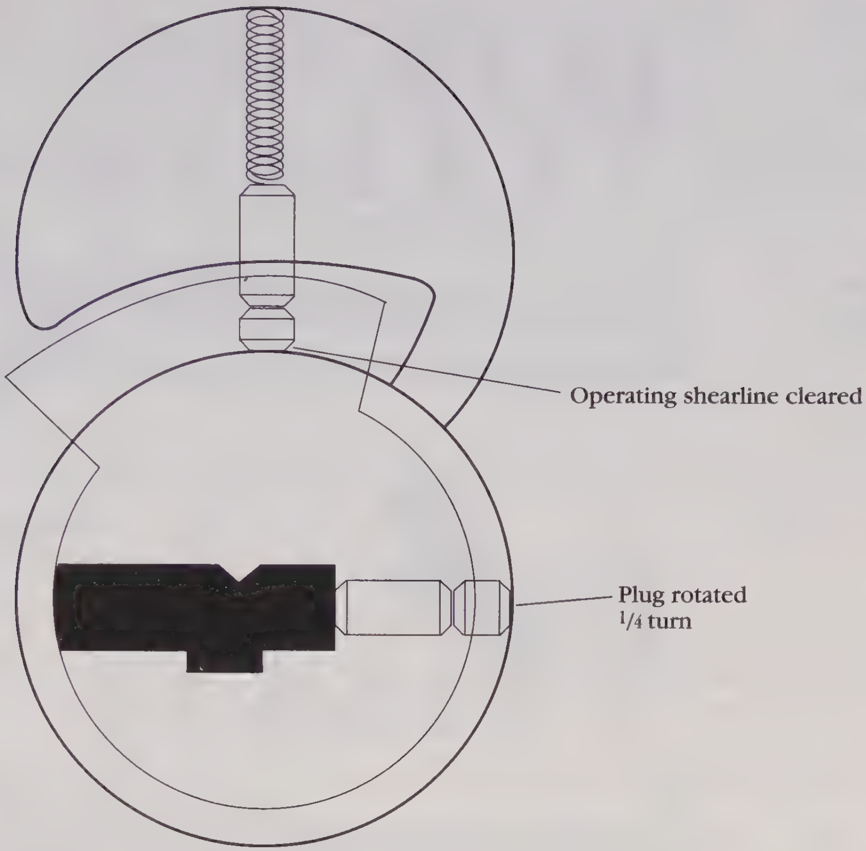
The control shearline is created between the shell and the sleeve. When the control key is inserted it clears this shearline and allows the sleeve, locking lug, and plug to be rotated 15 degrees. This will cause the locking lug to rotate into the core and remove the blocking obstacle, which allows the entire core assembly to be removed from the housing.



15-3 The operating shearline and the control shearline remain blocked when no key is inserted.



15-4 Shows how bottom, master, control pins and drivers sit in the assembly core.



15-5 Shows the operating shearline cleared and the plug rotated ¼ turn, with the key omitted for clarity.

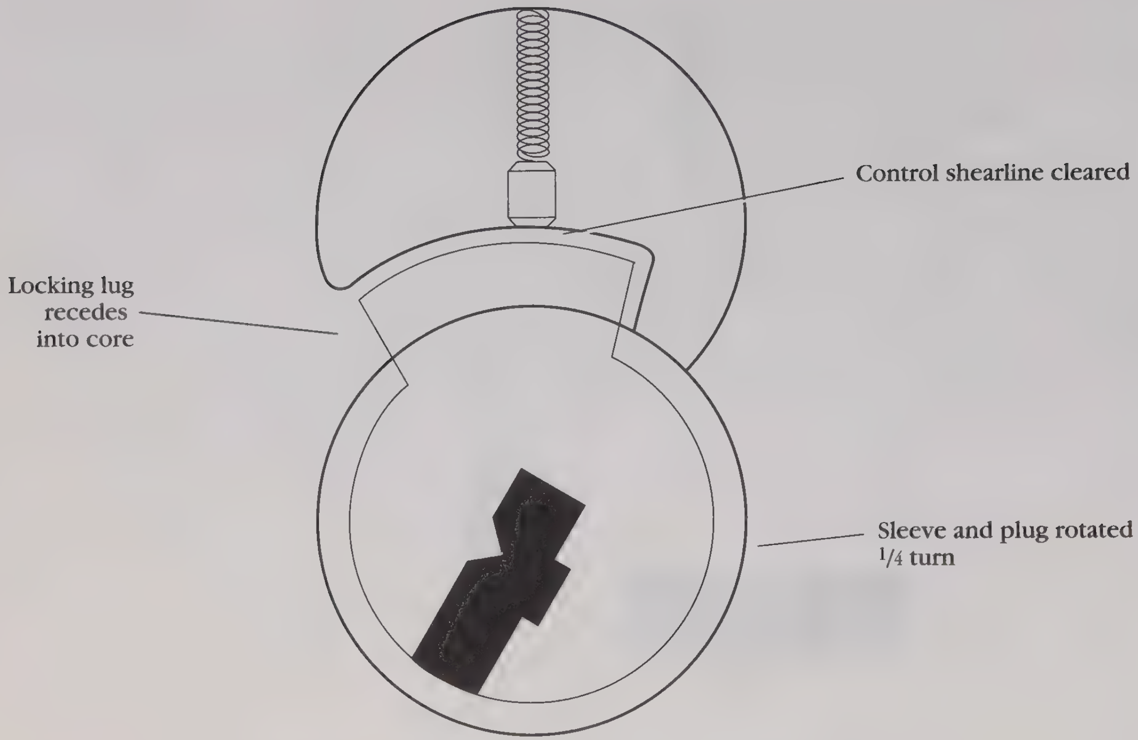
Figure 15-7 shows a side see-through view of how one pin assembly looks with no key inserted. Notice how the tops of all the pin stacks are at exactly the same height. This is done purposely to prevent the springs from being crushed when they are compressed and to allow equal compression on each stack of pins.

Figure 15-8 shows how the pins are positioned once an operating shearline is created. Only the top driver pins will block the control shearline. The operating shearline can be created with either the bottom pins or the master pins.

Figure 15-9 shows how the pins are positioned once the control shearline is created. Notice also in Figs. 15-8 and 15-9 how the key stop on the end of the key stops the key from going in too far and how it positions the spacings of the key perfectly below each pin chamber.

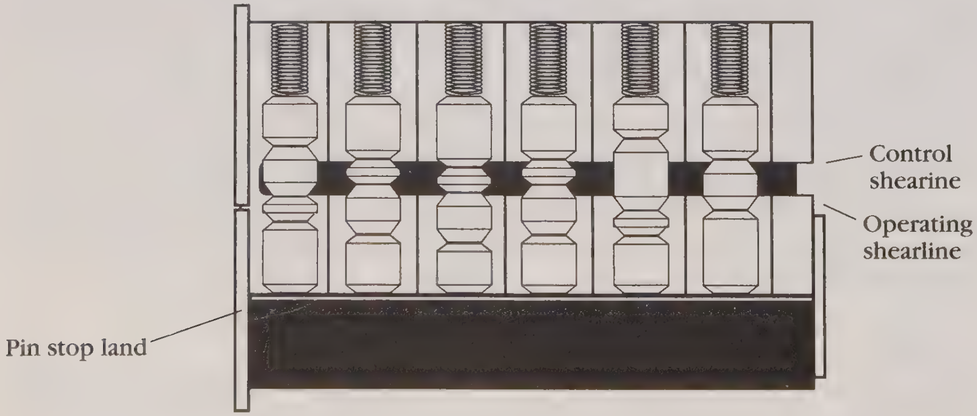
IC KEYS

IC keys differ from standard pin tumbler keys. IC keys have no shoulder stops at the bow. The key is stopped inside the plug by its key stop, which is at the tip end of the key (Fig. 15-10) and the plug retainer.

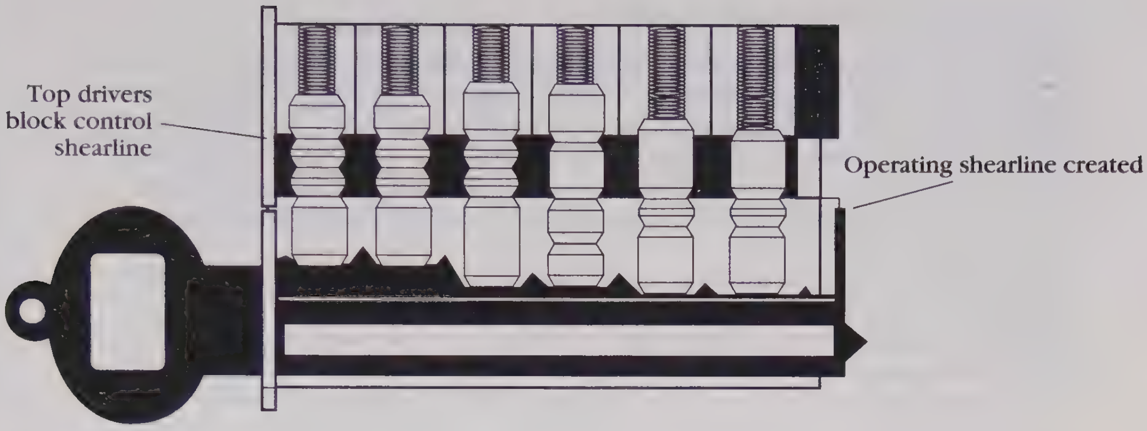

Control shearline cleared
Locking lug recedes into core
Sleeve and plug rotated 1/4 turn

15-6 Plug rotated 15 degrees when the proper control key is inserted and turned. Key omitted for clarity.

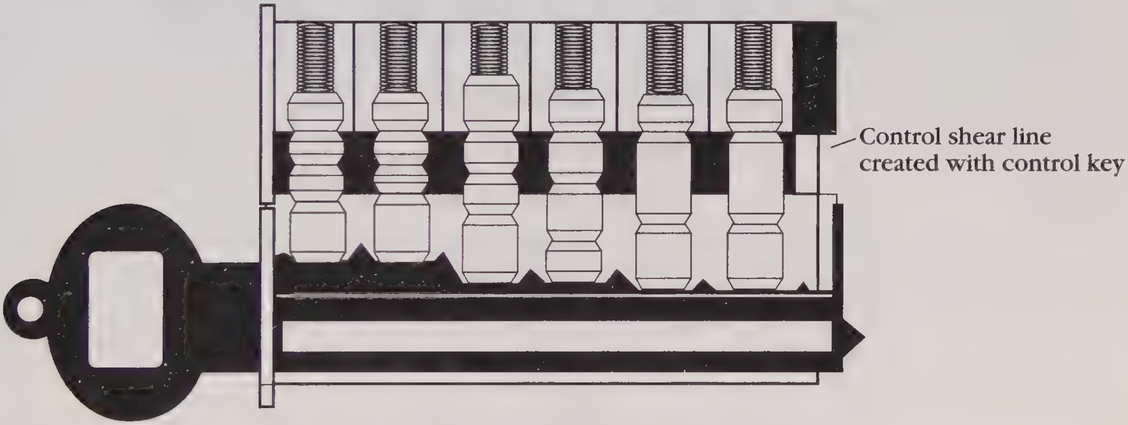
Spacing is also different from standard pin tumbler keys. IC keys are spaced from the stop of the key back towards the bow. The space furthest from the key bow will always be the #1 space position, whether or not the key is a six- or seven-spaced key. This will have an effect on how you pin IC cylinders. Always pin from the rear of the cylinder back toward the front.



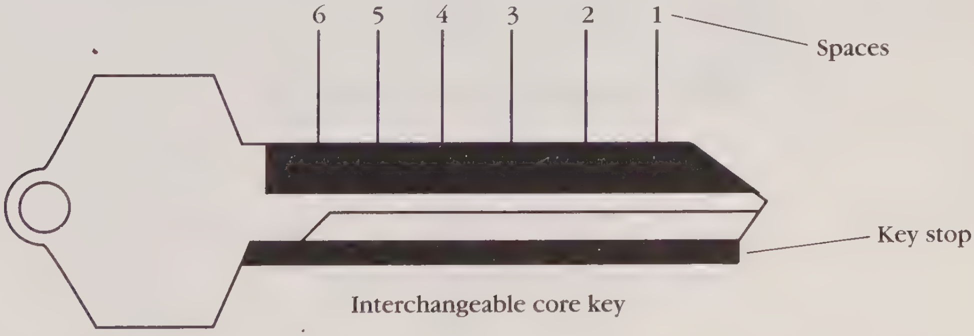
15-7 Each pin stack in each chamber sits at exactly the same height when no key is inserted.


Top drivers block control shearline
Operating shearline created

15-8 How the operating shearline and pin stack lies when the proper change key is inserted.



15-9 How the control shearline and pin stack lies when the proper control key is inserted.



15-10 An interchangeable core key. Notice the key stop at the end of the key, and the absence of a key shoulder.

Duplicating and originating IC keys

IC keys should always be cut by code. Don't duplicate them. This is because the tolerances in an IC-cylinder assembly are much more critical than those in standard pin tumbler cylinders. Because of the extra pin (control pin) and the sleeve, there is more chance for a slight "thousandths" of an inch to interfere with the proper operation of control keys, MKs, and CKs. Even though IC keys can be duplicated on standard duplicating equipment with special conversion fixtures, the chance of a duplicate key working smoothly is unlikely.

IC keys can be cut on most code-cutting key machines. This is the preferred method. To duplicate an IC key, decode the original key and then cut a new one by code. Many manufacturers of IC products make special code-cutting equipment (key punches) that can be used to cut their keys. Although this equipment is expensive, it is well worth the cost for the accuracy and smooth-working keys it produces.

It is important to position the IC key from the key stop, not the tip. Keys cut from tip to shoulder, even on a duplicator with both keys gauged from the tip, will probably not work correctly.

Most manufacturers of IC products and keys use what is known as the A-2 pinning system. This is the most common system used for ICs. The following shows the depths of cuts (0 to 9) for IC keys and the sizes of the bottom, master, control, and top pins.

A-2 pinning system

Depths of cuts

0-0.318
1-0.305
2-0.293
3-0.280
4-0.268
5-0.255
6-0.243
7-0.230
8-0.218
9-0.205

Bottom pin sizes

0-0.110
1-0.122
2-0.135
3-0.147
4-0.160
5-0.172
6-0.185
7-0.197
8-0.210
9-0.222

Master, control and top pin sizes

2-0.025
3-0.037
4-0.050
5-0.062
6-0.075
7-0.087
8-0.100
9-0.112
10-0.125
11-0.137
12-0.150
13-0.162
14-0.175
15-0.187
16-0.200
17-0.212
18-0.225
19-0.237

THE PIN STACK LENGTH

Because of the extra fourth pin (control pin) that is usually present in ICs, absolute control over the pin stack length of each chamber must be present. In standard pin tumbler cylinders there are usually two or three pins present in a chamber (the third being the master pin in master-keyed cylinders). In standard pin tumbler cylinders, no constant stack height must be observed, except for those in some high-security cylinders. In ICs, however, the addition of the extra pin (control pin) makes it absolutely necessary that the stack height be controlled to prevent the springs from being crushed when the key is inserted, and to maintain an equal compression of the pin stack in each chamber. To do this, a special pin-coding numbering system has been established, which is followed by all manufacturers of IC products. It is easier to learn this pin-coding system, rather than have to go by decimal measurements.

Rule #1:
The decimal measurement of each pin stack of ICs must measure 0.397 inch.
The pin-coding system for ICs is used in a manner similar to that of the pin-coding system for standard pin tumblers set forth by the various manufacturers. The main difference is that all the companies who manufacture ICs use the same exact pin measurements and depths of cut.

The following list shows the current coding system, including the \ code number, bottom pin length, and the corresponding depth of cut. The second list shows master, control, and top pin measurements and their conversion codes. Lists shown are for the A-2 pinning system only (Tables 15-1 and 15-2).

Table 15-1
Interchangeable core code conversion list

Code #	Bottom pin length	Depth of cut
0	0.110	0.318 (#0 cut)
1	0.122	0.305 (#1 cut)
2	0.135	0.293 (#2 cut)
3	0.147	0.280 (#3 cut)
4	0.160	0.268 (#4 cut)
5	0.172	0.255 (#5 cut)
6	0.185	0.243 (#6 cut)
7	0.197	0.230 (#7 cut)
8	0.210	0.218 (#8 cut)
9	0.222	0.205 (#9 cut)

Table 15-2
Master, control,
and top pin code conversions

Code #	Pin length
2	0.025
3	0.037
4	0.050

Table 15-2 Continued

Code #	Pin length
5	0.062
6	0.075
7	0.087
8	0.100
9	0.112
10	0.125
11	0.137
12	0.150
13	0.162
14	0.175
15	0.187
16	0.200
17	0.212
18	0.225
19	0.238

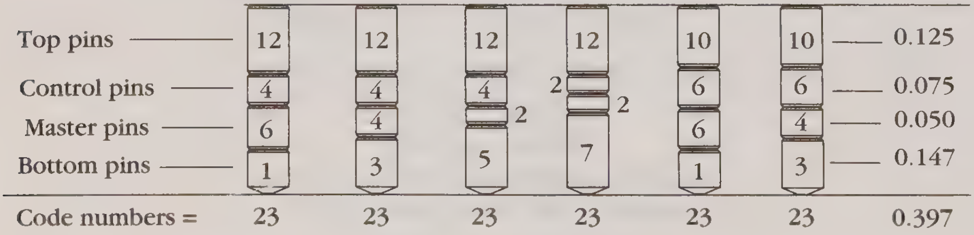
Note: Only pins #4 through #13 may be used as top pins (drivers).

Previously, I said that the total pin stack length in ICs must equal 0.397 of an inch, no more, no less. This figure, when transferred to code conversion numbers, equals 23.

Rule #2:

When using code numbers, the total pin stack length must equal 23.

For example, Fig. 15-11 shows the pins that might be used when pinning up an IC in a master-keyed system. Notice how the decimal equivalents (codes) add up to 23 in each chamber of the core assembly. Each pin stack height also equals 0.397 of an inch. As stated earlier, when pinning the core the height of each pin stack should be exactly the same when all the pins are loaded into all the chambers. If they are not, check the key cuts for the CK, MK, and the control key. Also check to be sure that the proper pins have been used.



15-11 Code number and decimal equivalents for a sample interchangeable core pinning. Each pin stack adds up to 23.

PINNING ICs

To pin master-keyed or nonmaster-keyed cores you must first determine the bittings of the control key, the top master key (TMK), and each CK. Master keying ICs is no different than master keying standard pin tumbler cylinders. Therefore, this chapter will not go into the discussion of master keying which has been discussed in chapter 14. The only bitting you need to know to master key ICs is the TMK, the highest level master key in any system. Because ICs are master keyed the same as standard cylinders, each lower-level MK, or submaster, will already be included in the pinning bittings and shearline possibilities.

One important selection in IC work is the bitting of the control key. It is preferable to choose bittings that are opposite that of the MK and CKs to avoid the possibility of those keys ever being duplicated to operate as a control key. You should never use a zero (0) for any of the bittings in a control key. If you did, a #9 bitting in an MK or CK would require a #1 control pin, which does not exist.

DETERMINING WHAT PINS TO USE

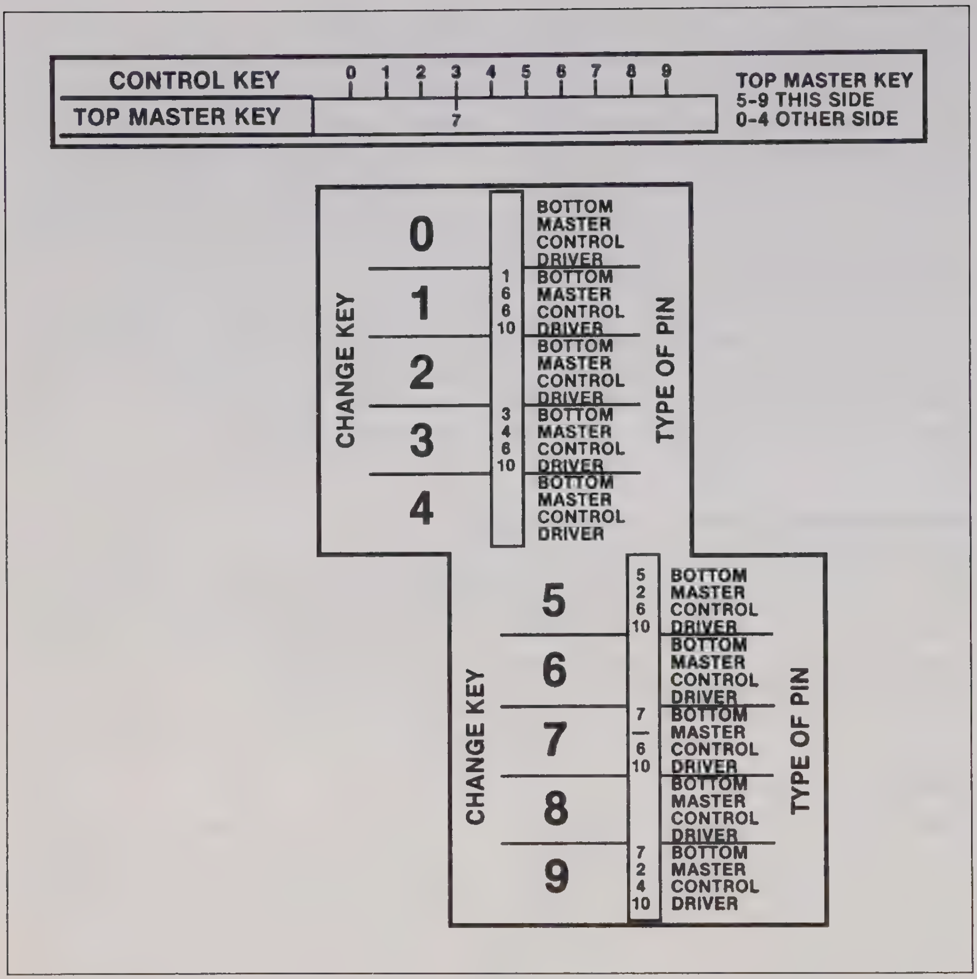
There are various methods that can be used to determine what pins to load into the core. The best of these methods is discussed in Master Locksmith G. L. "Gerry" Finch's book, *Servicing Interchangeable Cores: Book One* (there is also a book Two). Finch's technical books are some of the best in the locksmith industry. I recommend that you purchase and study Finch's books.

THE SLIDE CHART

In 1979, Gerry Finch invented the slide chart to help locksmiths determine the sizes of bottom, master, control, and driver pins to load into each IC-chamber assembly. This is the fastest method for finding the proper pinnings. As stated previously, all one needs to know to use this chart is the bittings of the control key, the MK, and each CK. Figure 15-12 shows an illustration of the slide chart. To use the slide chart, move the slide card so that the MK bitting number is in the slide window below the control key number. The proper pin sizes for each chamber for each corresponding CK will appear in the middle of the chart. This slide chart can be used for almost all ICs and is extremely convenient because of its small size and durability. The slide chart and Finch's book are available wherever locksmith supplies and technical aids are sold.

Figures 15-13 and 15-14 show sample pinning charts from *Servicing Interchangeable Cores: Book One.* These are just two of the charts listed in the book, which contains a complete set of charts that list every pinning possibility. To use these charts, find the control key bitting at the top, then intersect it with the MK bitting at the left. The box listings where the two meet contain the pinnings for all the possible CKs that might be used. Notice that all the pinnings shown add up to 23, the constant pin stack height.

Another method used to determine the pinnings for ICs is to use a pinning chart. A sample chart from *Servicing Interchangeable Cores: Book One* has been included in Fig. 15-15. This chart is self-explanatory.



G.L "Gerry" Finch

15-12 The slide chart is excellent for determining pin sizes to load into the core.

SERVICING

Several specialty tools are available that allow the locksmith to service and pin ICs. Some of these products can be purchased from IC manufacturers, others are after-market products that are generally cheaper and just as good for servicing ICs. The tools that should be purchased are capping blocks, pinning blocks, ejector tools, and blocks for servicing ICs. One well-known tool, manufactured by the A-1 Security Manufacturing Corp., is called The Block. The Block can be used to service and decode pin stacks and to determine control key bittings. It is especially helpful because it allows for the removal of all the pins and springs from the core, but keeps them neatly arranged separately and in original order on a fold-down tray that is part of the tool. Once servicing is complete, the entire pin stack can then be replaced. Figures 15-16 and 15-17 show some IC servicing products.

Control key bitting number

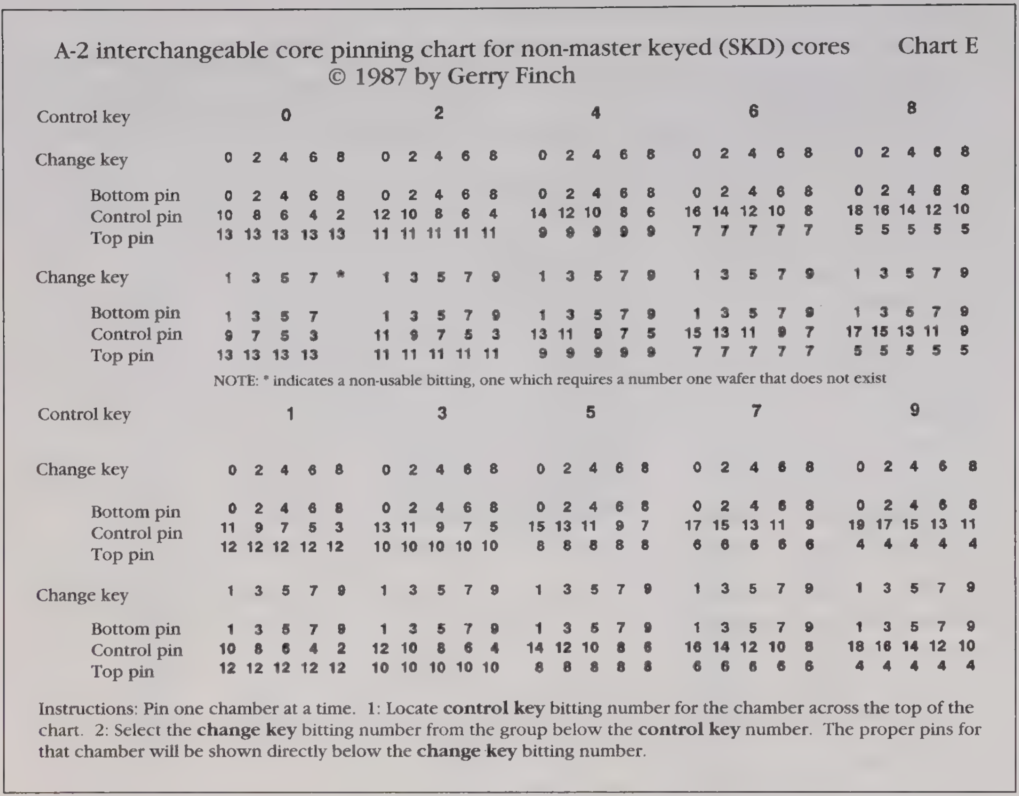
Chart A

Master key bitting number		1					3					5					7					9				
0	Change key	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
	Bottom pin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Master pin	-	2	4	6	8	-	2	4	6	8	-	2	4	6	8	-	2	4	6	8	-	2	4	6	8
	Control pin	11	9	7	5	3	13	11	9	7	5	15	13	11	9	7	17	15	13	11	9	19	17	15	13	11
	Top pin	12	12	12	12	12	10	10	10	10	10	8	8	8	8	8	6	6	6	6	6	4	4	4	4	4
2	Change key	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
	Bottom pin	0	2	2	2	2	0	2	2	2	2	0	2	2	2	2	0	2	2	2	2	0	2	2	2	2
	Master pin	2	-	2	4	6	2	-	2	4	6	2	-	2	4	6	2	-	2	4	6	2	-	2	4	6
	Control pin	9	9	7	5	3	11	11	9	7	5	13	13	11	9	7	15	15	13	11	9	17	17	15	13	11
	Top pin	12	12	12	12	12	10	10	10	10	10	8	8	8	8	8	6	6	6	6	6	4	4	4	4	4
4	Change key	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
	Bottom pin	0	2	4	4	4	0	2	4	4	4	0	2	4	4	4	0	2	4	4	4	0	2	4	4	4
	Master pin	4	2	-	2	4	4	2	-	2	4	4	2	-	2	4	4	2	-	2	4	4	2	-	2	4
	Control pin	7	7	7	5	3	9	9	9	7	5	11	11	11	9	7	13	13	13	11	9	15	15	15	13	11
	Top pin	12	12	12	12	12	10	10	10	10	10	8	8	8	8	8	6	6	6	6	6	4	4	4	4	4
6	Change key	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
	Bottom pin	0	2	4	6	6	0	2	4	6	6	0	2	4	6	6	0	2	4	6	6	0	2	4	6	6
	Master pin	6	4	2	-	2	6	4	2	-	2	6	4	2	-	2	6	4	2	-	2	6	4	2	-	2
	Control pin	5	5	5	5	3	7	7	7	7	5	9	9	9	9	7	11	11	11	11	9	13	13	13	13	11
	Top pin	12	12	12	12	12	10	10	10	10	10	8	8	8	8	8	6	6	6	6	6	4	4	4	4	4
8	Change key	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
	Bottom pin	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
	Master pin	8	6	4	2	-	8	6	4	2	-	8	6	4	2	-	8	6	4	2	-	8	6	4	2	-
	Control pin	3	3	3	3	3	5	5	5	5	5	7	7	7	7	7	9	9	9	9	9	11	11	11	11	11
	Top pin	12	12	12	12	12	10	10	10	10	10	8	8	8	8	8	6	6	6	6	6	4	4	4	4	4

Instructions: Pin one chamber at a time. 1: Find **control key** bitting number acreoss top of page. 2: Find **master key** bitting number on left side of page. 3: **Change key** bitting number will be in the group where the **control key** and **master key** lines intersects. 4: Pins to load in this chamber will be shown directly below the **change key** bitting number.

G.L "Gerry" Finch

15-13 Control key bitting sheets can be used in place of the slide chart. This sheet is for master-keyed interchangeable cores.



A-2 interchangeable core pinning chart for non-master keyed (SKD) cores Chart E
© 1987 by Gerry Finch

Control key	0					2					4					6					8				
Change key	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
Bottom pin	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
Control pin	10	8	6	4	2	12	10	8	6	4	14	12	10	8	6	16	14	12	10	8	18	16	14	12	10
Top pin	13	13	13	13	13	11	11	11	11	11	9	9	9	9	9	7	7	7	7	7	5	5	5	5	5
Change key	1	3	5	7	*	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9
Bottom pin	1	3	5	7		1	3	5	7	9	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9
Control pin	9	7	5	3		11	9	7	5	3	13	11	9	7	5	15	13	11	9	7	17	15	13	11	9
Top pin	13	13	13	13		11	11	11	11	11	9	9	9	9	9	7	7	7	7	7	5	5	5	5	5

NOTE: * indicates a non-usable bitting, one which requires a number one wafer that does not exist

Control key	1					3					5					7					9				
Change key	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
Bottom pin	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8	0	2	4	6	8
Control pin	11	9	7	5	3	13	11	9	7	5	15	13	11	9	7	17	15	13	11	9	19	17	15	13	11
Top pin	12	12	12	12	12	10	10	10	10	10	8	8	8	8	8	6	6	6	6	6	4	4	4	4	4
Change key	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9
Bottom pin	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9
Control pin	10	8	6	4	2	12	10	8	6	4	14	12	10	8	6	16	14	12	10	8	18	16	14	12	10
Top pin	12	12	12	12	12	10	10	10	10	10	8	8	8	8	8	6	6	6	6	6	4	4	4	4	4

Instructions: Pin one chamber at a time. 1: Locate **control key** bitting number for the chamber across the top of the chart. 2: Select the **change key** bitting number from the group below the **control key** number. The proper pins for that chamber will be shown directly below the **change key** bitting number.

G.L. "Gerry" Finch

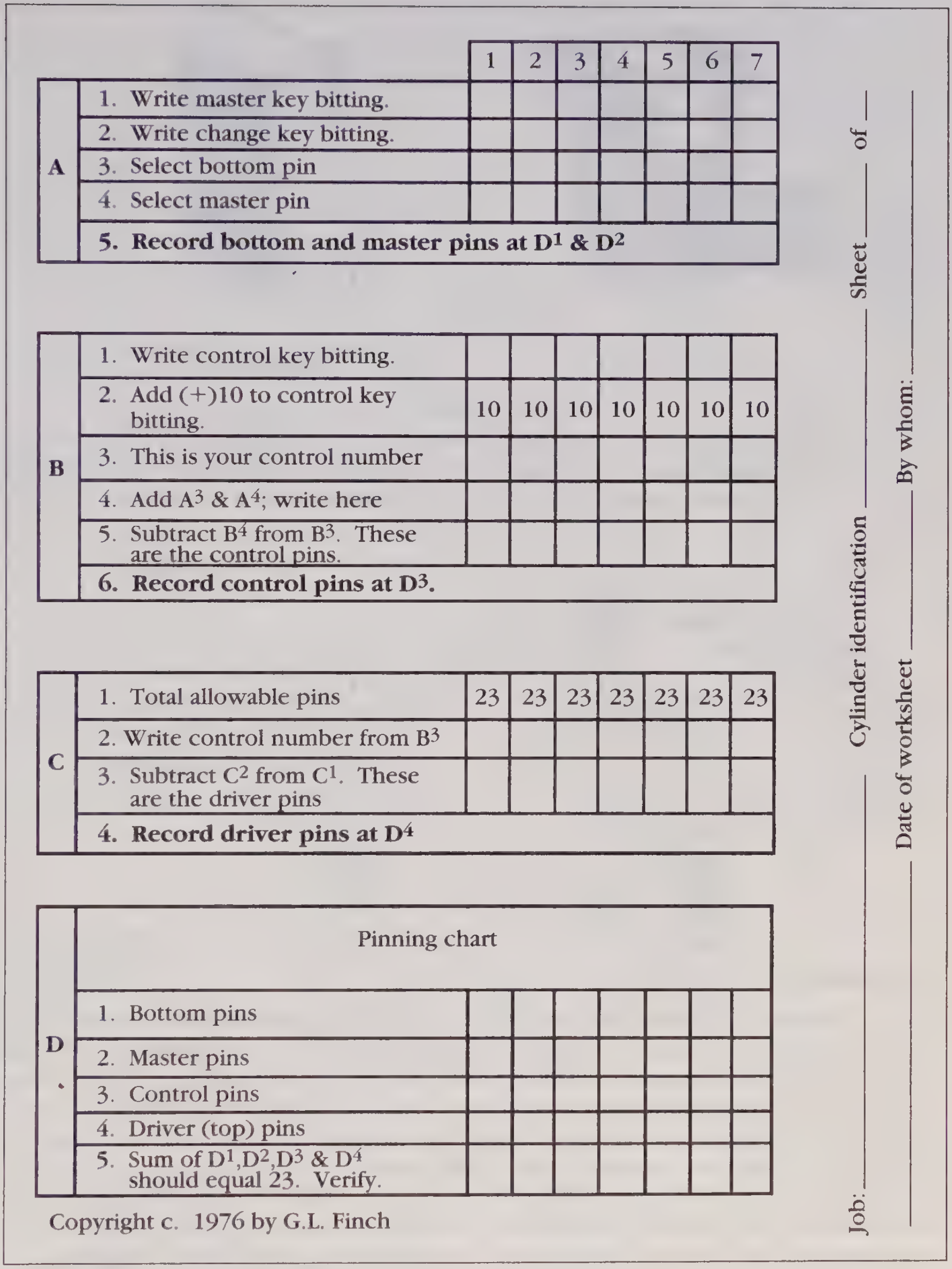
15-14 This sheet is for determining pinning requirements for nonmaster-keyed interchangeable cores.

DECODING THE CORE FOR THE CONTROL KEY BITTING

There will be many times when a locksmith will be asked to supply a control key for an existing IC system. Many times customers move to new locations and have not been given the control key. It is impossible to remove the core quickly for rekeying purposes without the control key. (Although there are procedures that can be used to remove the core without the control key, these will not be covered in this book for security reasons.) To decode an IC in order to obtain the proper control key bitting, you need to know the measurement of the top pin (driver). Once you measure the top pin with a dial caliper, you can perform some mathematics using the formula shown below to get the control key bitting.

The following information is derived from the book, *Servicing Interchangeable Cores, Book One*, by G.L. "Gerry" Finch.

Measured length of top pin	0.062	0.075
Multiplied by 80 equals	4.96	6.00
Raised to whole number	5	6
Subtracted from	13	13
Control key bittings =	8	7



		1	2	3	4	5	6	7
A	1. Write master key bitting.							
	2. Write change key bitting.							
	3. Select bottom pin							
	4. Select master pin							
	5. Record bottom and master pins at D^1 & D^2							

B	1. Write control key bitting.							
	2. Add (+)10 to control key bitting.	10	10	10	10	10	10	10
	3. This is your control number							
	4. Add A^3 & A^4; write here							
	5. Subtract B^4 from B^3. These are the control pins.							
	6. Record control pins at D^3.							

C	1. Total allowable pins	23	23	23	23	23	23	23
	2. Write control number from B^3							
	3. Subtract C^2 from C^1. These are the driver pins							
	4. Record driver pins at D^4							

D	Pinning chart							
	1. Bottom pins							
	2. Master pins							
	3. Control pins							
	4. Driver (top) pins							
	5. Sum of D^1,D^2,D^3 & D^4 should equal 23. Verify.							

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Job: ______ Cylinder identification ______ Sheet ______ of ______

Date of worksheet ______ By whom: ______

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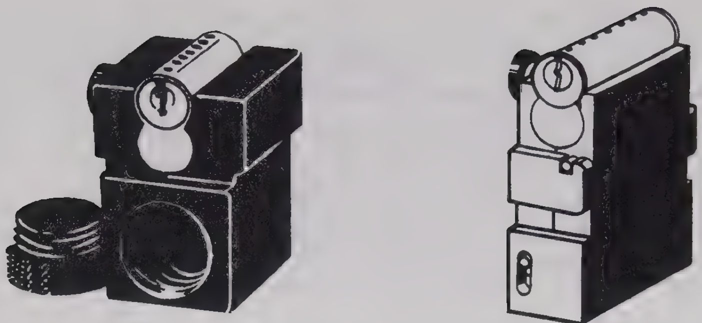
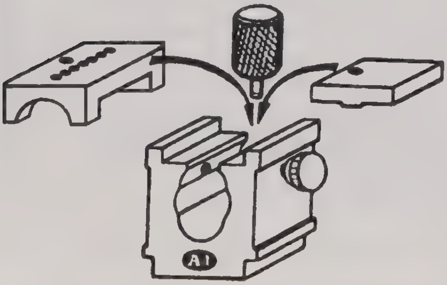
15-15 This pinning sheet can also be used to determine the bottom pins, control pins, master pins, and top pins.



Dumping block

The block

15-16 The dumping block dumps and holds pins and springs from dozens of cores made by Best, Eagle, Arrow, and Falcon. The block allows removal of the entire pin stack yet at the same time leaves each pin completely in place on a swing-away tray. Accredited Lock Supply Co.



Capping block

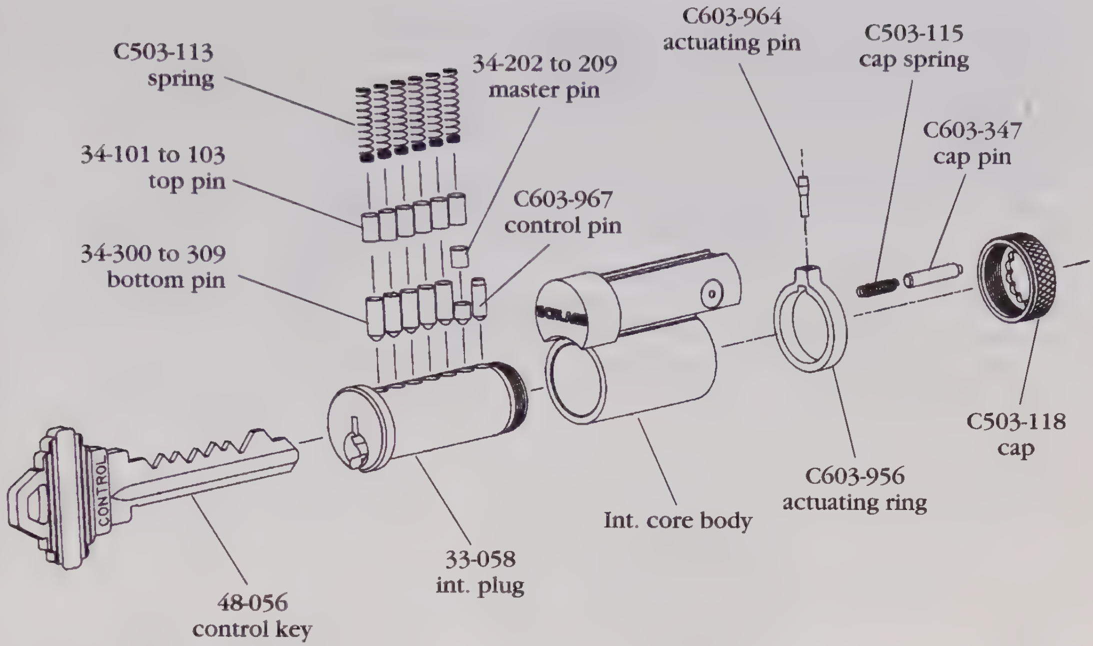
15-17
A pinning and capping block. The hand tool shown at the top is used for properly seating the pin stack. G.L. "Gerry" Finch.

SCHLAGE IC CYLINDERS

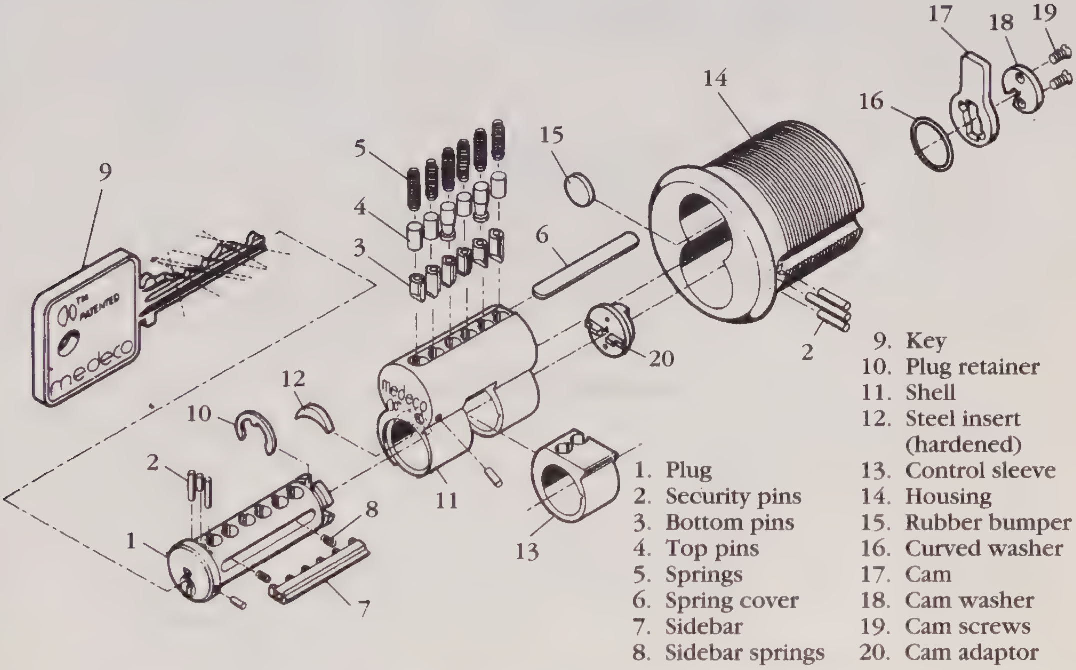
Figure 15-18 shows an exploded diagram of a Schlage IC cylinder. This IC product differs greatly from the system just explained due to the fact that it does not use special control pins or any other specially coded pin system in all the chambers. What it does use is a spring-loaded pin that is positioned in the end of the plug, much like that of a normal pin chamber. All the pins, drivers, and springs in the rest of the cylinder are standard parts used in all Schlage pin tumbler cylinders. The control key of a Schlage IC cylinder differs from Schlage's other keys in that it is slightly longer (about the size of a 6½- or 7-spaced blank). The tip of the control key is cut to a #5 depth. To remove the core, the control key is inserted into the plug and rotated about 15 degrees.

MEDECO IC CYLINDERS

Many manufacturers of high-security locks also produce ICs. Medeco High Security Locks is one of them. Figure 15-19 shows an exploded view of Medeco's IC cylinder.



15-18 Exploded view of an interchangeable core. Schlage Lock Co.

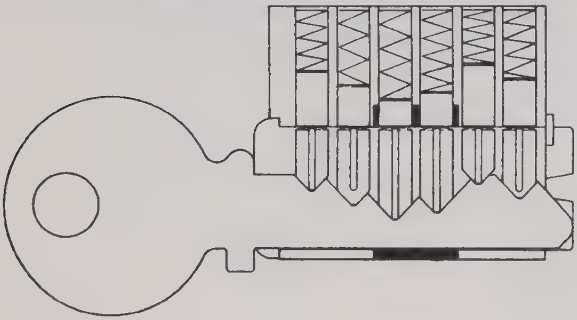


15-19 Exploded view of a Medeco interchangeable core cylinder. Notice the control sleeve and how it slips into the center of the core. Medeco High Security Locks

This product differs from many others because the cylinder only utilizes two chambers and a two-chamber control sleeve to operate the core retainer.

Figures 15-20 and 15-21 show how a Medeco IC operates. For keyed-alike and keyed-different cylinders it is not necessary to use master wafers or special control pins for the control key operation. Figure 15-20 shows a Medeco IC with the standard operating key inserted. The pins are correctly elevated and rotated, as with standard Medeco cylinder operation, for the standard shearline. The centrally located core retainer is shown darkened. Figure 15-21 illustrates the same core with the control key inserted. The pins are correctly elevated and rotated for the control shearline. Pins in cut positions #3 and #4 are elevated .090 inch higher than the operational shearline so that the core retainer will release.

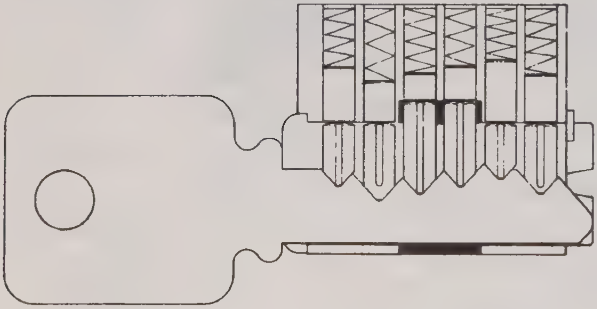
Note: Many manufacturers use different designs and operating principles for ICs. It is suggested that you obtain all the technical information you can about the specific products before you attempt to service them.



15-20

Shows the standard operating key having no effect on pins 3 and 4.

Medeco High Security Locks



15-21

Pins in position 3 and 4 are now elevated to the proper height for releasing the core.

Medeco High Security Locks

16

Automotive locksmithing

Over the past two decades, automotive lock work has become a large and rapidly growing part of the locksmith profession. The advanced technological locking systems in today's domestic and foreign automobiles have increased the demand for qualified service personnel. Because of the skills and tools needed to service these locks, most of the work performed on these cars is done by locksmiths. Those of you who intend to perform automobile lock work be prepared. Automotive locksmithing demands extensive study, skills, supplies, and tools, as well as determination and patience.

This chapter will help you understand the basic operation and a few of the servicing procedures for domestic car locks, including door, ignition, trunk, and glove compartment locks. I will focus on four domestic automobile manufacturers: General Motors (GM), Ford, Chrysler, and Saturn, and the GM VATS/PASSKEY systems. Airbags and their servicing will also be covered because this is an important and much required safety feature on many automobiles that directly ties into the servicing procedures for some ignition locks.

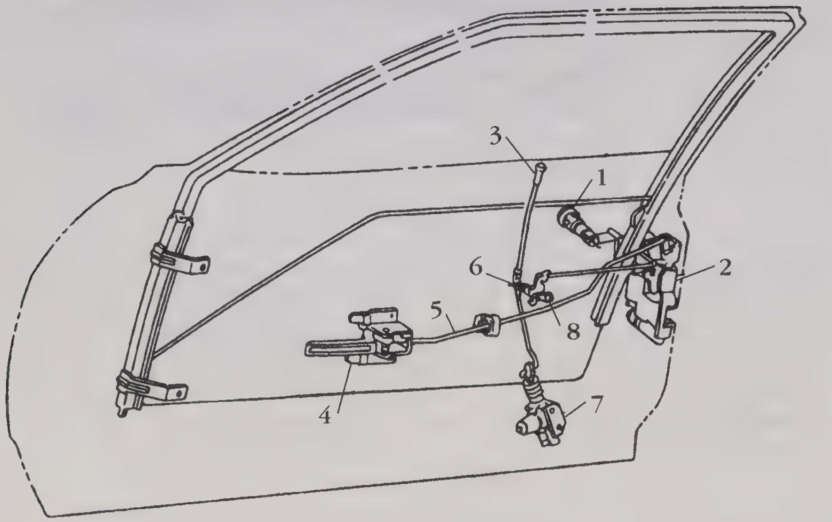
For the public's vehicle security, and to maintain the industry's high ethics of keeping the right information out of the wrong hands, this chapter will not tell how to open locked car doors or how to circumvent automobile ignition systems. Once you become a licensed, certified, or professional locksmith you will be able to obtain this information.

DOMESTIC AUTOMOBILE LOCKS

Most domestic automobile locks operate under one of three tumbler variations: pin tumbler, wafer tumbler, or sidebar wafer tumbler. Like regular house and commercial locks, automobile door locks have a pawl or cam that connects to the rear of the lock plug and when moved activates part of the locking system. In automobile locking systems, a linkage rod is connected to the door latch. It is the turning or rotating action of the lock plug and pawl combined and the raising or lowering of the linkage rod that locks or unlocks the door.

Figure 16-1 shows the inside of a typical door lock linkage and latch assembly. Notice how each linkage rod connects separately to the locks and the inside and outside handles. The door locks on most domestic cars are held onto the door panel by a C-clip.

1 Door lock
2 Locking assembly
3 Inside locking rod with vertical button
4 Inside handle
5 Inside handle connecting rod
6 Locking rod bell crank
7 Door lock actuator
8 Bell crank rivet (attaches bell crank to the inner door panel)



16-1 Inside door panel blowup that shows lock linkages and related assemblies. The Locksmith Publishing Co.

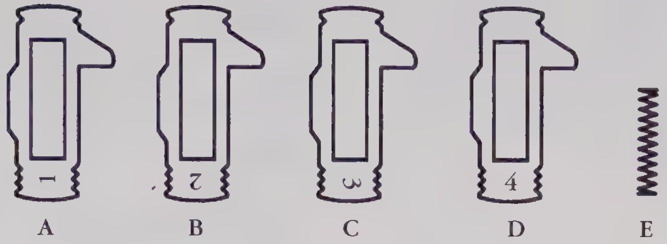
Wafer door locks

Most automobile locks use one of the two wafer tumbler designs. Figure 16-2 shows a few of the wafer tumbler designs for Chrysler's domestic auto locks. Notice that some of the wafers are listed as double-bitted (double-throw) wafers. There are two kinds of wafer designs in automobile locks: single-throw wafers and double-throw wafers. Single-throw wafers move in only one direction when a key is inserted, either all up or all down. Double-throw wafers move in both directions, some up and some down.

In a single-throw wafer lock, all the wafers will flush out at the shearline of the lock. The shearline will be at either the bottom or top of the plug, depending on how the key is inserted into the lock (with the cuts either down or up). In a double-throw wafer lock, there are two shearlines, one at the bottom of the plug and one at the top, and the key is cut on both the top and bottom of the blade. This is what is known as a convenience key. The key can be inserted into the lock either way and will work both ways. Figures 16-3 and 16-4 show the differences between a single-throw wafer and a double-throw wafer and the shearlines that must be cleared.

Automotive wafer tumbler locks are either staked into place (snapped in) or held in place by the housing. Both versions use springs to supply constant tension. Some wafers are also serrated on their sides to increase lockpicking resistance. Wafer tumbler locks are used in GM, Ford, Chrysler, Saturn, and many foreign automobile locks.

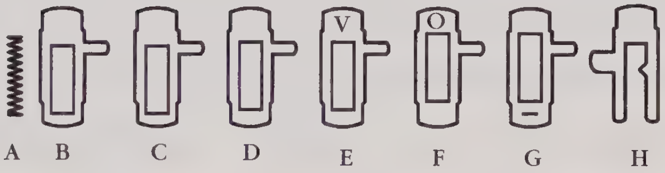
Chrysler double bitted
1989–current



A–321761 Tumbler #1
B–321762 Tumbler #2
C–321763 Tumbler #3
D–321764 Tumbler #4
E–46890 Tumbler spring

All

Chrysler plate–0.020 depth change
1969–1990



A–46650 Spring
B–320310 Tumbler #1
C– 72310 Tumbler #2
D– 72340 Tumbler #3
E–82293 Tumbler #4
F–32503 Tumbler #5
G–32504 Tumbler #6
H–320455 Retainer tumbler

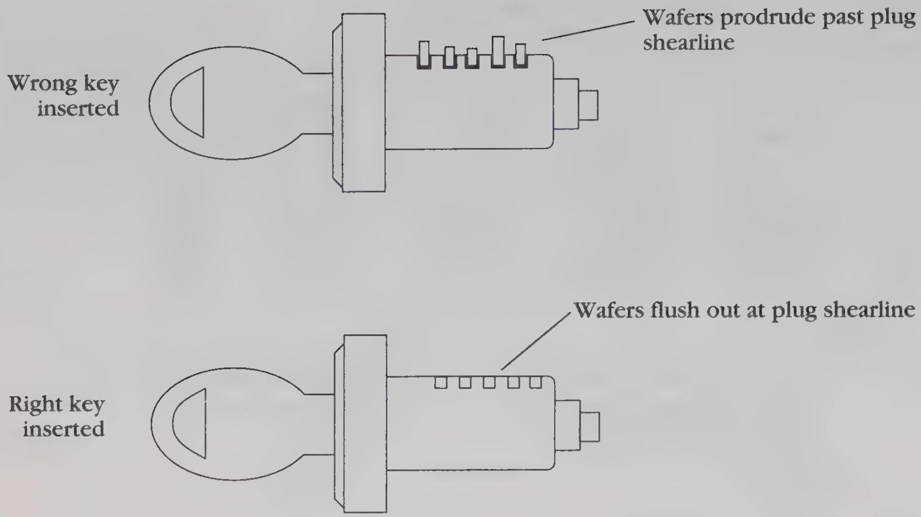
Glove box–fuel filler

16-2 Chrysler single-throw and double-throw wafers. Briggs & Stratton Technologies

Wafer sidebar locks

The wafer sidebar is a common lock design. A sidebar acts as the locking mechanism that prevents the rotation of the plug. The wafer tumblers are v-notched on their side at different heights to correspond with different key-cut depths. When the proper key is inserted, the v-notches on the tumblers line up in a centerline in the plug and allow the v-shaped edge of the sidebar to retract into the v-notches on the wafers, which clears the sidebar obstacle and allows the plug to be rotated. See Figs. 16-5 and 16-6.

Sidebar wafer tumblers are secured in place by a spring retainer cap, which in turn is staked into place above the springs and wafers. Sidebar locks have been used extensively in GM ignition, door, and trunk locks, and are now also used in Ford ig-

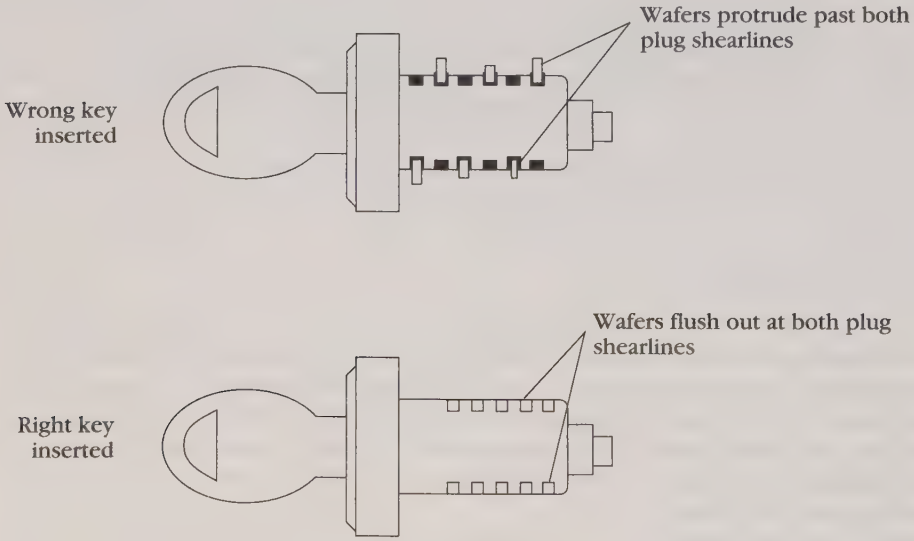

Wafers prodrude past plug shearline
Wrong key inserted
Wafers flush out at plug shearline
Right key inserted

16-3 Single-throw wafers in an automobile door lock and their positions with the wrong key and then the proper key.

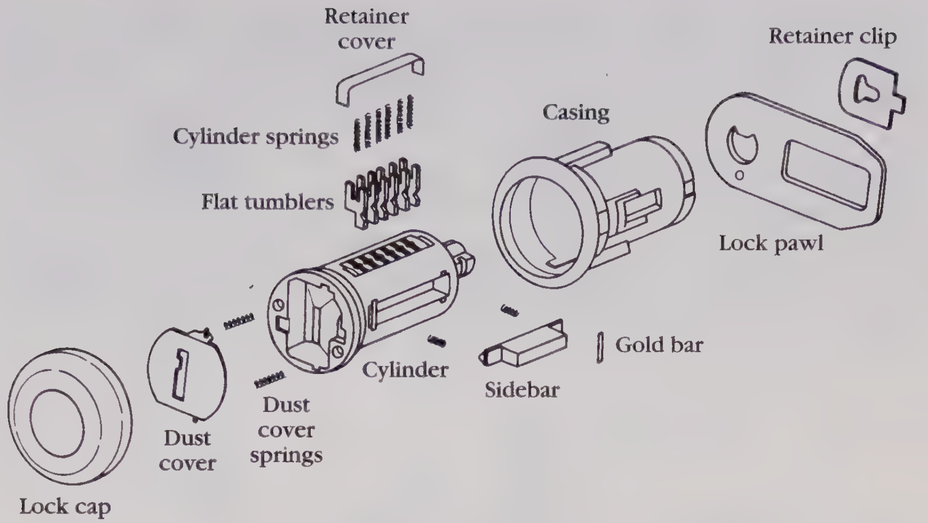
nition automobile locks. Chrysler, Saturn, and most foreign car locks use the standard single- and double-throw wafer design.

Lock designs and keying information

During the last decade, ignition, door, trunk, and glove compartment locks have undergone many operating design changes and keying arrangements. This is due mostly

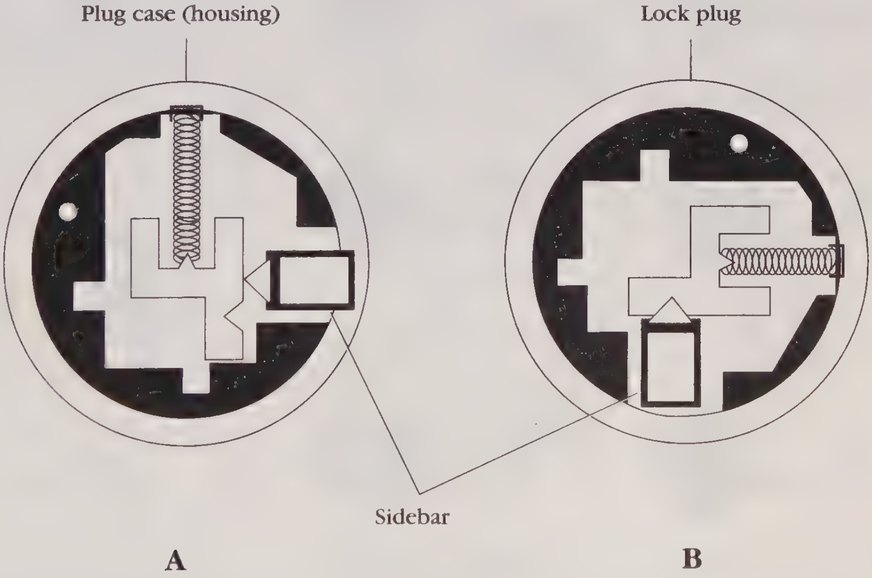

Wafers protrude past both plug shearlines
Wrong key inserted
Wafers flush out at both plug shearlines
Right key inserted

16-4 Double-throw wafers in an automobile door lock and their positions with the wrong key and then the proper key.



16-5 Exploded view of a GM sidebar door lock. The Locksmith Publishing Co.

to the big three car manufacturers' attempts to reduce the number of automobile thefts. Because of these changes locksmiths must expend an enormous amount of time and money to research and keep up with the servicing procedures for these locks. Complicating this is the fact that all of the big three car manufacturers can, at

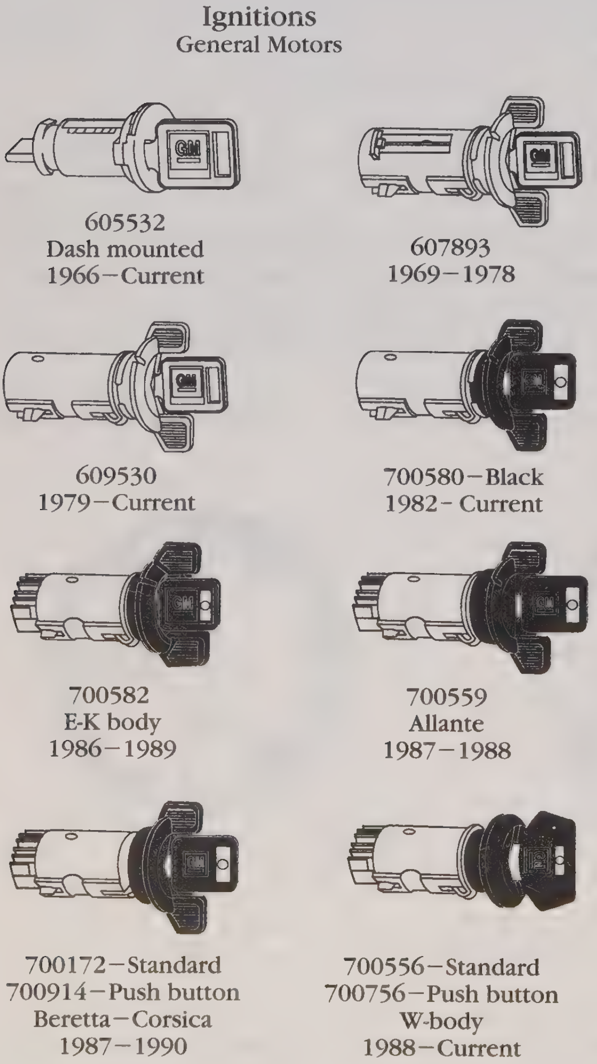


16-6 A shows the relationship of the sidebar to the wafer tumblers when no key is inserted or when an incorrectly cut key is used. B shows the lock plug rotated and the sidebar snapped into the v-notches of the tumblers when the correctly cut key is used.

any time, change the ignition, door, trunk, and glove box lock designs for some, if not all, of their models. In the next few sections, I will describe in general terms the types of lock designs that have been used over the past seven years. By the time you read this book, however, some of these systems might already have been changed.

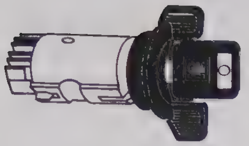
GENERAL MOTORS

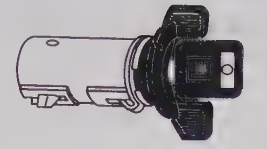
Since the mid 1950s, GM has used the wafer-sidebar lock exclusively in all their car locks, except the glove compartment. Since 1974, two keys operate all the locks in the car: one for the ignition and one for the doors, trunk, and glove box, or secondary, locks. Figures 16-7 and 16-8 show the style of ignition locks used for each make and model, including the VATS/PASSKEY ignition lock system.

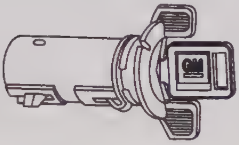


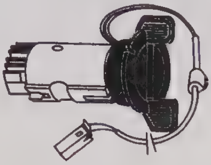
16-7
GM style ignitions. Briggs & Stratton Technologies

Ignitions
General Motors

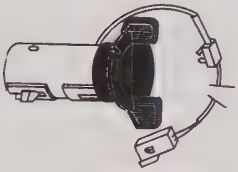

701405—Standard
701409—Push button
Beretta—Corsica
W/tilt
1991—Current

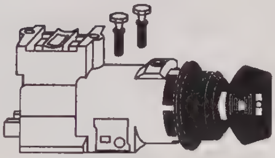

700580—Standard
701410—Push button
Beretta—Corsica
Without/tilt
1991—Current

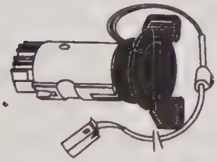

701759
1992—Current "B" car


700754—Standard
700938—Push button
VATS
1986—Current

16-8
GM style ignitions including VATS ignitions.
Briggs & Stratton Technologies


700930
VATS—Sector gear
1989—1991 E-K-V body


702166
702211—Push button
Alpha Tec


701286
VATS
48 pin connector

GM fleet ignitions

Panel	Groove	Column
592249	B	608361
592250	D	608528
592251	H	608529
592252	K	608530

There are four primary keyways for GM ignition locks, and four secondary keyways for doors, trunks, and the glove box. Table 16-1 shows which keyways are used for each model year.

Table 16-1
GM key blank chart

Groove	Years of application
50-A	67 71 75 79 83–88
51-B	
54-C	68 72 76 80 87–90
55-D	
56-E	69 73 77 81 91–Current
57-H	
58-J	70 74 78 82
59-K	

Source: Briggs & Stratton Technologies

The keying specifications for GM locks have remained the same since 1966. GM bittings call for five depths and six spaces. The depths are:

GM cut depths

#1 cut = 0.248
#2 cut = 0.223
#3 cut = 0.198
#4 cut = 0.173
#5 cut = 0.148

There are certain keying rules that must be understood and observed when rekeying GM locks. The first rule is that no two adjacent cuts can have a depth difference greater than two. Since there are five depths, you can never have a #1 cut next to a #4 cut. The next rule is that no one particular cut depth can repeat itself more then three times in a row. For example, a key cut to 122322 is acceptable, but a key cut to 122223 is not. The last rule is that the sum of the key cuts must add up to an even number. For example: 122322 = 12. Following these rules will help you determine key-coding information for secondary locks using key-coding progression or impressioning techniques. It should be remembered that the ignition lock is the only lock on a GM car that contains the lock's original code number.

Servicing GM car locks

A locksmith might find it necessary to remove the ignition lock on a car if the original keys have been lost, or if the original code to the lock is not available. At other times, removal of all the locks might be necessary if the locks have been vandalized or if the owner wishes to have the locks rekeyed.

All GM door and trunk locks are held in place with a U-shaped retainer clip. The clip slips into two grooves in the rear of the lock's housing from behind the door and trunk panel. To remove a GM door lock you must first remove the inside door panel. Tools used specifically for this purpose have been shown elsewhere in this book. You can then reach into the rear of the door lock, pull off the U-shaped retainer clip, and snap off the linkage rod retainer that holds the linkage rod to the lock pawl. This frees the lock and lets you pull it out.

In almost all cases, the steering-column-mounted ignition lock on GM cars must be removed if the original code is lost. To do this you will have to perform a series of steps. Because many GM ignition locks are secured to the column by a retaining screw located inside the column, you must remove many parts, including the steering wheel, horn pad, lock plate, lock ring, turn signal and actuator arm, and, in the newer cars, the airbag. Additional parts must be removed from telescoping columns. There are many good technical books that will teach you step by step how to perform these procedures. Keep in mind, however, that many of the newer cars have sophisticated electronic circuitry that runs to the controls connected to the horn pad. When you work on these cars and the ignition locks on any of the new cars that have airbags or VATS, be careful not to create any static discharge that might severely damage these circuits. It is suggested that you ground yourself to the vehicle with a special grounding mat or wrist strap that connects to the car. Once you remove the ignition lock you can decode the code stamped on the ignition-lock housing and cut the proper key, or install a new ignition lock, whichever is quicker.

GM progression method

Because of the keying rules that GM follows, fitting a key for the glove, door, and trunk locks is much simpler than for the ignition. The progression method enables you to fit a key to all the secondary locks by removing only the glove compartment lock.

There are seven different glove-compartment lock designs in GM vehicles. Therefore, I have not included instructions on how to remove them. In most cases, however, glove compartment locks can be picked open because they are wafer tumbler, not wafer sidebar, locks. (Detailed steps for opening glove box locks are available in many technical publications available to the locksmithing industry.)

Some glove box locks contain only four wafers, some have all six. If all six are present, you will need to make a working key for the glove box lock. That key will then open the door and trunk locks. Most of glove box locks will have only four wafers, usually in the 3rd, 4th, 5th, and 6th positions. This means that the #1 and #2 spaces will have to be determined.

Once the lock is removed you can fit the key in the 3rd, 4th, 5th, and 6th positions using either a hand-code cutter, file, depth and space keys and a duplicator, or an electric code machine. The steps outlined below will teach you how to use the GM progression method to determine the remaining two cuts that will operate the trunk and door locks. Remember to follow the GM bitting rules.

Below are two lists, one for bittings of the glove box lock that add up to an even number and one that adds up to an odd number. The total of the key bittings from the glove box lock will tell you which list to use. Using this method will limit the number of needed key blanks to a maximum of three.

1. Decode the bittings from the glove box lock. Example: Cuts in spaces 3, 4, 5, and 6 = 1, 3, 1, 2.
2. Add the found bittings together. Example: 1,3,1,2 = 7
3. If the sum is an even number, use list #1. If the sum is an odd number, use list #2.

List #1 (even sum)	List #2 (odd sum)
1st key blank	1st key blank
11	12

22
33
44
55
2nd key blank
13
24
35
3rd key blank
31
42
53

23
34
45
2nd key blank
21
32
43
54

4. Using our example bitting 1, 3, 1, 2 = 7, cut a 1 in the first space of the key blank, and a 2 in second space of the key blank. Try the key. If it does not work, go to the next cut, which would be 23. Remember to cancel out the cuts which when added to the glove box bittings do not equal an even number, and the adjacent cuts that have a difference greater than 2. Following our example, you would not use the 34, 45, or 54, because the 4 bitting in the second space would equal more than the 2 next to the 1 bitting in the third space.

FORD

Ford automobile locks differ from GM locks. In 1984, Ford vehicle locks changed drastically. Previously, all Ford car locks were a 5-spaced pin tumbler design. (Because of their similarity to standard pin tumbler operation, pin tumbler car locks have not been explained thoroughly in this chapter.)

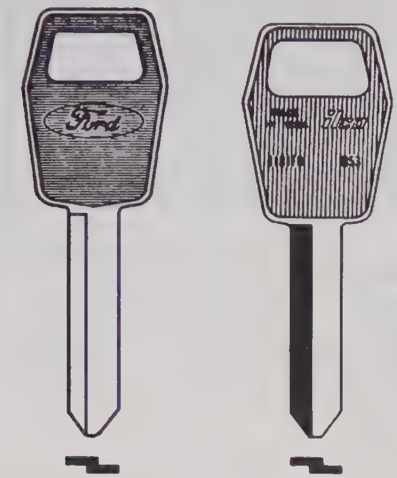
Ford now uses a wafer-sidebar ignition lock and a wafer door lock. Glove compartment locks use wafer tumblers. Trunk locks still use pin tumblers.

Ford car locks also differ in that they can be removed easily from the ignition and door. To remove the ignition lock in order to replace it, all you have to do is separate the two plastic shrouds that fit around the steering column. The newer top shrouds can usually be removed by hand (snapped off). The bottom shroud has a few screws that must be unfastened. Right below the ignition lock is a retaining pin. Squeeze in the retaining pin to release the lock. The ignition lock, however, must be turned to the "on" position with the key, or by picking, drilling, or impressioning for it to be completely removed.

Ford car door locks can be removed by opening the door and pulling out the retaining clip that is visible at the inside edge of the door. You do not have to remove the door panel.

Ford keying information

As stated earlier, since mid 1984 most Ford ignition and door locks have the Ford 10-cut tumbler design. This system utilizes a key that contains 10 spaces, or cuts, and is used to operate the ignition and door locks. This does not mean, however, that the ignition and door locks each have 10 tumblers inside them. The wafer sidebar ignition locks have six tumblers and are operated by the 5th through 10th cuts on the key. The door locks also have six tumblers in them, but are operated only by cuts 1 through 6 on the key. The door locks and the ignition locks share cuts 5 and 6, as shown in Fig. 16-9. The Ford 10-cut key also uses its tip as the key stop.


Use: New 1984½ and up

1983–84

16-9
The Ford 10-Cut key shown actual size.

Ford uses progression methods to determine original key cuts, both for their pre-1984 pin tumbler locks and the 10-cut key system. By removing the door lock and determining the key cuts in the 5th and 6th positions, cuts 7 through 10 can be progressed to supply a properly cut key for the ignition. Because of the length of these progression charts they will not be included in this book. Locksmith automotive service manuals and locksmith technical books list these progression methods and charts in great detail.

Below is the list of depths for the Ford 10-cut system. The 10-cut key uses five depths with a drop of 0.026 inch between cuts. The Ford 10-cut key is gauged from the tip of the key, with the cut nearest the tip considered the #1 cut. Ford also follows some keying rules for their 10-cut system:

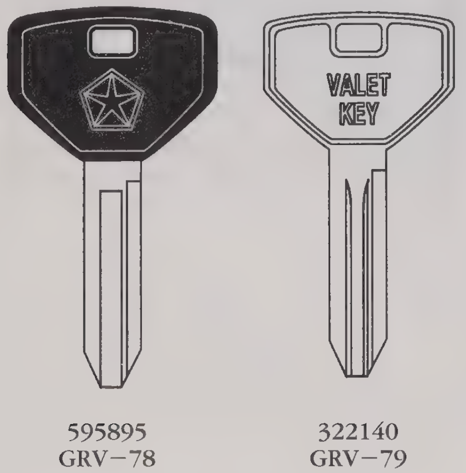
1. No adjacent cuts may be greater than two depths. Depths 1 and 4, 1 and 5, and 2 and 5 will never appear next to each other.
2. No code will use less than three different depths.
3. A code will never begin with three of the same depths in a row, but can end with three of the same in a row.

Depths

#1 cut = 0.352
#2 cut = 0.326
#3 cut = 0.301
#4 cut = 0.275
#5 cut = 0.250

CHRYSLER

Chrysler began changing their keying system in 1989. Prior to that year, all Chrysler locks contained pin tumblers. One key operated the ignition and doors and another key operated the trunk. In 1989, Chrysler implemented a new double-bitted locking system on two models: the Plymouth Acclaim and the Dodge Spirit. These keys use seven spaces and four depths, are cut on both sides, and are used as a convenience key. The 1989 cars use single-throw wafers in all the locks, again numbered 1 through 4. This system uses two keys also, but one is considered a master key (MK) and the other operates as a valet key. The MK can operate all the locks of the car; the valet key can only operate the ignition and doors. The purpose of a valet key is to keep parking and service personnel from obtaining access to storage compartments. Figure 16-10 shows the differences between the MK and the valet key.



16-10
Chrysler's master and valet key blanks. Briggs & Stratton Technologies

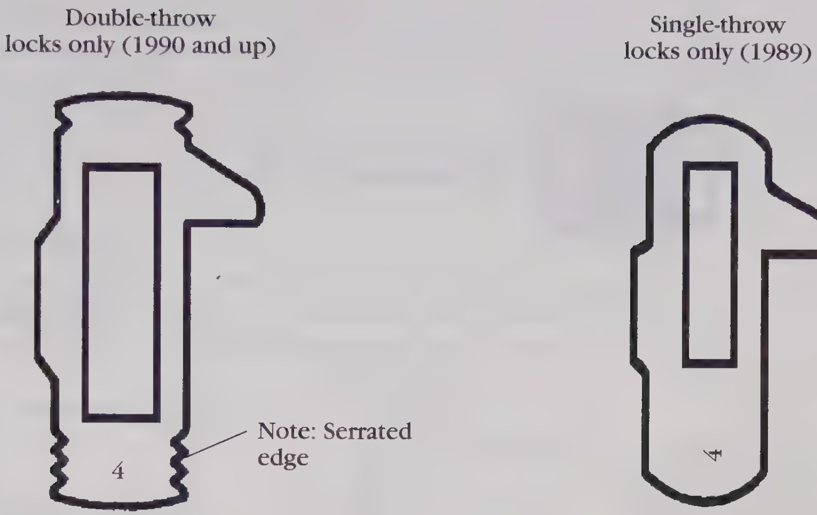
In 1990, Chrysler changed all the locks in their passenger cars and most of their trucks to the double-bitted locking system (double-throw wafers). These wafers are of the double-throw, serrated wafer design to increase lockpicking difficulty. The differences between the two tumblers are shown in Fig. 16-11. The new double-throw wafers are not compatible with the single-throw wafers.

The bitting chart in Fig. 16-12 shows the location arrangement of all the tumblers in each lock for the years 1989 to 1992.

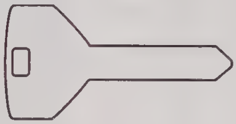
In 1993, Chrysler added a new key groove (78 primary, 79 valet) to initiate a keyway-restricted valet system and introduced their new J-Series codes. That year they also added a 7th tumbler in the ignition locks. In 1994, they again introduced a new key groove (84 primary, 85 valet) and their new L-Series codes. The spaces and depths of the keys remain the same, with seven spaces and four depths. The 1993 keys will not fit into the keyways of the 1994 locks and vice versa.

SATURN

As of 1993, Saturn was offering only four models: SL Sports Sedan, SL2 Sports Touring Sedan, SC Sports Coupe, and SW Station Wagon. Like Chrysler, Saturn locks use



16-11 Chrysler's single-throw and double-throw wafers. Briggs & Stratton Technologies

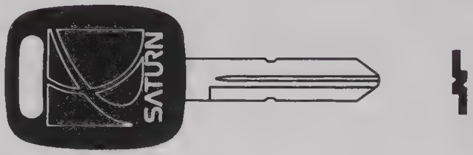


Bitting chart

Lock assembly	1	2	3	4	5	6	7	
Ignition	X	X	X	X	X	X	X	all 7 cuts
Door			X	X	X	X	X	last 5 cuts
Rear compartment			X	X	X	X	X	last 5 cuts
Glove box					X	X	X	last 3 cuts
Seat back					X	X	X	last 3 cuts

16-12
Chrysler key bitting chart. Briggs & Stratton Technologies

seven spaces and four depths. The four different tumblers found in Saturn locks are snapped-in and correspond to the four different key depths. They also have the tumbler numbers stamped on them. The Saturn key is double-sided and reversible, which makes it a convenience key. None of the codes are stamped on any of the Saturn locks. When new customers pick up their cars they receive a plastic bag with a bar-coded paper label. The last 4 characters of the bar code label identify the key code. Like the Chrysler double-bitted system, the Saturn key is gauged from tip to bow. Figure 16-13 shows the bitting chart arrangement for the Saturn locking system.



Bitting chart

Lock assembly	1	2	3	4	5	6	7	
Ignition	X	X	X	X	X	X		1st 6 cuts
Door		X	X	X	X	X		
Rear compartment			X	X	X	X	X	last 5 cuts

16-13 Saturn key bitting chart. Briggs & Stratton Technologies

VATS/PASSKEY

Since 1989, GM has incorporated a new antitheft ignition system into many of its cars. Other car manufacturers have also announced plans to equip some of their models with the VATS/PASSKEY antitheft ignition system.

The GM VATS/PASSKEY antitheft ignition system was designed to curtail the rising number of auto thefts and to help lower insurance costs. The entire system is totally self-operational and does not require the owner of the car to understand, activate, or service any part of it. Because of its mechanical and electrical differences from other automobile antitheft devices, it does require that locksmiths who intend to service the ignition locks on these cars be thoroughly informed and trained as to how the system works and how it is serviced.

The parts of the VATS/PASSKEY ignition system that affect locksmiths are the ignition keys and the ignition locks. The basic operation of the system is easy to understand. All VATS keys are fitted with a resistor pellet that is embedded into the ignition key right above the shoulder. This resistor pellet can be any one of 15 different resistor pellets that have been designed for the VATS/PASSKEY system. Each one of these resistor pellets supplies a different resistor value. The 15 different resistor values and keys are:

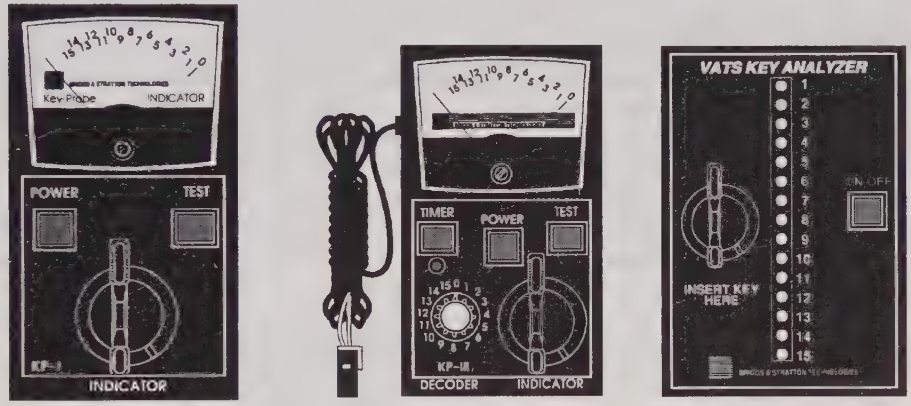
1. 402 ohms
2. 523 ohms
3. 681 ohms
4. 953 ohms
5. 1.13 Kohms
6. 1.47 Kohms
7. 1.87 Kohms
8. 2.37 Kohms
9. 3.01 Kohms
10. 3.74 Kohms
11. 4.75 Kohms
12. 6.04 Kohms
13. 7.50 Kohms
14. 9.53 Kohms
15. 11.80 Kohms

Operation

When the proper mechanically cut ignition key is inserted into the ignition lock and turned, the resistor pellet makes contact with two electrical contacts that are fitted inside the ignition plug. These contacts are connected directly to the VATS module, which sits below the dashboard. The VATS module is the heart of the system and connects directly to the starter and the fuel system. When the key is turned, the module determines if the resistor pellet in the key has been programmed at the module to work with that car. If the resistor value in the pellet matches, then the starter circuit will operate along with the fuel system and the car will start. If the resistor pellet does not match, then the car will not start for a predetermined amount of time.

VATS servicing

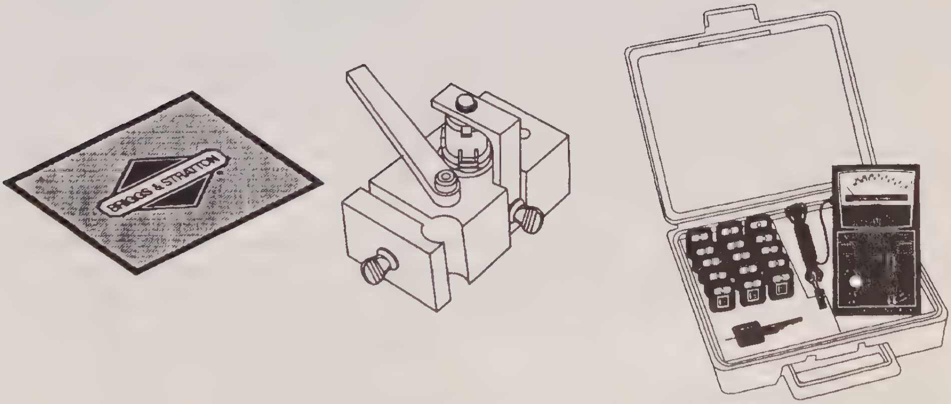
When called upon to service a VATS equipped car, you will have to either duplicate the key, originate a new key, or replace the ignition lock. Regardless of the service performed, special tools will be required. Figure 16-14 shows the tools and equipment



Key probe I
701880

Key probe III
701881

Key analyzer
701915



Work mat
702167

GM capping fixture
596391

VATS service kits
702221

16-14 VATS tools and test equipment. Briggs & Stratton Technologies needed to service VATS keys. (The tools shown here are manufactured by Briggs & Stratton Technologies. Other manufacturers' VATS servicing tools can also be used.)

Key duplication

The key analyzer can be used to determine the resistor value of an ignition key, if all you need to do is duplicate the key. The key analyzer will read the resistor value of the VATS key and light up the proper key number. An alternative to the use of the key analyzer is to read the resistance value of the pellet with an ohmmeter or multimeter. Simply place the two probes of the meter across each side of the resistor pellet, then read the resistance value recorded on the meter. Both methods will tell you which key needs to be used for duplication. The VATS key can then be duplicated in the standard manner.

Replacing lost ignition keys

If the owner of a VATS-equipped car loses the ignition keys and does not have the original mechanical key-cut codes, then a new mechanical key must be originated. In addition, the proper resistor value must also be determined. To learn these servicing procedures there are many good technical articles and books available to professional locksmiths that will teach you these procedures step by step. Contact The Locksmith Publishing Corporation, publisher of The Locksmith Ledger Magazine, for a list of books on the subject. In addition, instructions will come with all the tools and equipment you purchase to service VATS.

There are a few things you should know, however, before you decide to try your hand out at originating ignition keys on VATS-equipped cars.

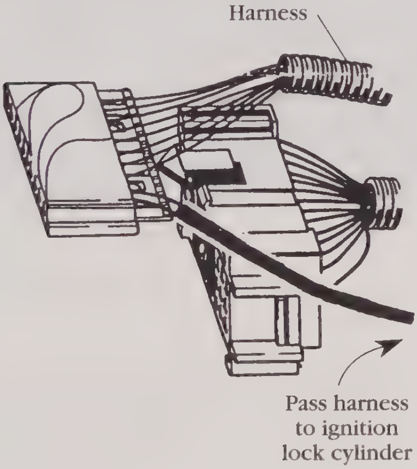
1. An airbag might have to be removed first. To do this, you will have to be familiar with airbag servicing procedures. The next part of this chapter briefly discusses airbags.
2. The correct mechanically cut key must be made. This involves removing the steering wheel, lock plate, and other parts to obtain the key code that is stamped on the ignition lock. Use the standard procedures for removing the ignition lock on all the different types of GM columns.
3. You must disconnect from the VATS module the two-wire connector that leads down from the ignition lock in order to be able to plug in the connector that leads into the resistor testing product you are using.
4. The clutch must be depressed before you test start the car because there is an electrical cutoff that will prevent the car from starting if the clutch is not depressed.
5. There can be up to a four-minute delay time between resistor-value tests.
6. Some of the newer cars use a 48-pin connector wiring harness that also includes the VATS wiring. A special adapter must be used with this type for testing.

Replacing a VATS ignition lock

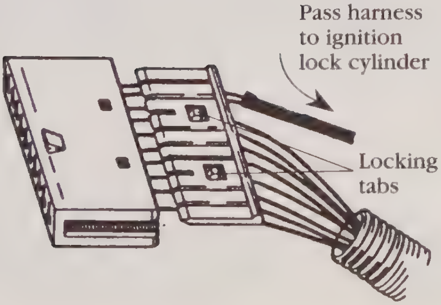
Sometimes it might be necessary for a locksmith to completely replace a VATS ignition lock. This might have to be done if the lock is destroyed through vandalism or attempted theft. The steps below outline the procedures for removing the VATS wires from the 48-pin connector below the dashboard.

1. Disconnect the negative terminal on the battery and wait 10 minutes for the S.I.R. system (airbag) to dissipate.
2. Locate the 48-pin connector under the dashboard. It is usually located behind the fuse panel or just to the left of the steering column. Loosen the metric bolt in the middle of the harness and pry the connector apart.
3. Locate the VATS leads in the lower portion of the connector and slip the flat wiring assembly forward by gently prying between the connector body and the flat plastic retainer (Fig. 16-15).
4. Remove the wiring lock by pushing down on the detents and sliding the wiring lock out of the back of the wiring assembly (Fig. 16-16).
5. Use the Kent-Moore tool J-38125-13. Insert the tool into the front of the wiring assembly. This should allow the VATS wires to slide easily out the rear (Fig. 16-17).
6. Remove and reinstall the VATS ignition lock as you have in the past.
7. The new wires will snap into place where the old wire leads were removed.
8. Reassemble the connector in reverse order of disassembly (Figs. 16-15 through 16-17).

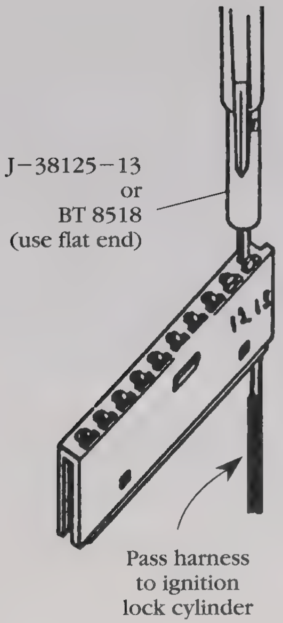
Note: Always see vehicle service manual for instructions before servicing this or any VATS-equipped vehicle.



16-15
Shows the flat wiring assembly being pushed forward. Briggs & Stratton Technologies



16-16
Shows the wiring lock being removed from the flat wiring assembly. Briggs & Stratton Technologies



16-17
Shows special Kent-Moore tool being used to free the VATS wires. Briggs & Stratton Technologies

AIRBAGS

As of September 1993, all new cars sold in the United States had to be equipped with driver and passenger-side airbags. This important safety feature will hopefully prevent countless deaths and injuries for all drivers and front-seat passengers. An airbag is part of a supplemental, passive-restraint system that includes not only the airbag, but also automatic seat belts.

Basic operation

Most airbags are activated only by front-end collisions. This means any impact to the car on the sides or the rear will not deploy the airbag. Most airbags will be activated within the range of 14 to 30 miles an hour, according to manufacturer's specifications and triggering principles. Most cars have up to four sensors mounted on the car's frame. These sensors are designed to not only trigger the airbag at the time of collision, but also to differentiate between false triggering impacts such as direct blows to the car's bumper from vandalism. Once an airbag is activated it will remain inflated for about one second.

Servicing

Locksmiths who service ignition locks must be thoroughly trained in servicing and operational procedures for airbags. This not only includes servicing procedures, but also safety precautions because airbags contain a back-up power supply that deploys the airbag if power to the vehicle is cut off at the moment of impact.

Safety precautions

Electrostatic discharge and any contact with an electrical source can accidently deploy an airbag, even when the car is not running. Observe the following safety precautions before and while removing airbags from steering wheels.

1. Remove both the negative and positive terminals from the battery.
2. Wait the recommended delay time before you remove the airbag to allow the back-up power supply to discharge (approximately 15 minutes).
3. Ground yourself to the vehicle before you touch the airbag. Use a ground mat, a grounding strap, or touch any metal object in the car that is connected to the car's metal body.
4. Always use the proper tools to remove airbag units.
5. Never place the airbag module face down on the car seat, in the trunk, or anywhere else. This will limit movement of the module should it accidently deploy.
6. If you walk with an airbag, never place it directly in front of you in case it accidently deploys.
7. Never replace the screws or other fasteners that attach the airbag to the steering wheel with any other types of fasteners. Use only manufacturer-approved fasteners.
8. Look for back-up batteries for alarm systems, custom stereo systems, tapes, CD players, etc. These back-up supplies can provide power, depending on how they are wired to the vehicle, that can cause the airbag to deploy.
9. Always check the airbag system light (LED) for proper operation. This light will always be found somewhere on the dashboard. The light should go on for four to eight seconds once the ignition is turned to the "on" position. If it doesn't, or acts in any other kind of way do not service the airbag. Have the owner tow the car to the manufacturer to have the airbag system serviced.

Removal of airbags

Airbags need only be removed on those cars that must have the steering wheel removed to gain access to the ignition lock. This eliminates airbag removal for all Ford cars, since Ford cars do not need to have the wheel removed. The main difference between cars without airbags and cars with airbags is the addition of a revolving coil assembly/clockspring component that is used to supply constant power to the airbag module. This component sits directly below the steering wheel, rotates with the canceling cam tower and must be lifted out of the way to gain access to the lock.

The most important precaution to take when removing airbags is to prevent the coil assembly/clockspring from rotating freely before and after it is lifted up from the steering shaft. In Chrysler cars, this is prevented by inserting a set screw (which is stored on the steering wheel) through an access hole in the rotor of the steering wheel. When installed, the set screw seats itself into the clockspring and locks the clockspring into place, preventing the coil ribbon from unwinding; the steering wheel can then be removed.

In General Motors cars, the clocksping is prevented from unwinding by placing a supplied locking screw into the "Center Lock" position of the coil assembly hub. The hub can then be taped (using duct tape) to the coil housing. In addition, some

General Motors cars have a locking tab coil assembly that automatically locks the hub's position into place once it is lifted off the steering column. Fortunately, if the Chrysler or General Motors' clockspring assemblies do unwind, they can be rewound into place.

Because of limited space, this chapter does not include steps for removing airbags and clockspring assemblies. I suggest you purchase the previously mentioned technical reference books to learn all the detailed steps and procedures.

System checkouts

Once an ignition lock has been removed, a key cut and the airbag, clockspring, and all the other additional parts have been re-installed, you should test the airbag system functions. Because of the possibility, however, of accidental deployment, these tests should be performed in the most safe and cautious manner possible. These precautions should be observed regardless of whether the airbag has been removed from the steering wheel during ignition lock removal procedures. (You can learn these proper steps and procedures by purchasing the technical reference books I mentioned).

IMPORTANT THOUGHTS

Servicing cars with VATS/PASSKEY and airbags is more involved than servicing cars without these systems. Prior to 1990, only a select few domestic cars included these systems, thus it was not extremely important for locksmiths to involve themselves with these type cars. After 1990, however, and especially after the 1993 model year, it will be absolutely necessary for locksmiths who want to do automotive work to learn the servicing procedures and system operations of airbags and VATS/PASSKEY.

There is more than one alternative. You can attend the many locksmith seminars on automotive locksmithing courses offered by locksmith magazines, distributors, schools, associations, conventions, etc. You can also purchase the forementioned technical reference books, or others like them that are sold throughout the industry. Never, never attempt to service any of these vehicles until you have had the proper education and training.

17

Modern alarms

During the past decade, more and more locksmiths have become involved in the installation and sales of residential and small commercial burglar alarm systems. This has become even more evident since the development of wireless alarm systems. Involvement in this lucrative part of security business greatly increases a locksmith's profits and customer base.

Before you decide to get involved with alarm work, there are quite a few things you need to know about how today's microprocessed alarm systems are installed and operated. In this chapter, I will introduce you to the main components of these advanced systems, how they are hooked up, and how they operate. This chapter, however, is by no means a complete study in the theory and operation of burglar alarm systems. For a more complete course, I recommend you purchase alarm installation books that are available to the locksmith industry and/or you might contact national burglar alarm associations for information on basic and advanced courses.

CONTROL PANELS

The control (panel) is the brains, or "heart," of an alarm system. It is where all the electrical input signals are interpreted and acted upon. Present-day controls use micro-computer-based technology to supervise and program the alarm system's operational features, monitor protective loops, trip local sounding devices, and transmit digital-coded messages to central-monitoring stations.

The complex miniature circuitry in control panels today offers numerous advantages over the earlier type controls of the past that used sensitive relays and latching bell drop relays to monitor protective loops and trip local sounding devices. (Although relays are still used in control panels today, they are used mainly as relay outputs, or dry contacts, to provide a switching point to control accessory devices that must be triggered upon alarm, such as strobe lights, house lights, etc.)

Present-day controls are designed to operate with either conventional alarm wiring, two-wire multiplexing (polling loop), wireless, or sometimes a combination of the three. Conventional alarm wiring is still the most commonly used, therefore I will devote most of my discussion to this type of control. No matter what type of control is used, all will possess most, if not all, of the control features discussed in this book. The only difference between them is the method utilized to transmit system status information back to the control.

Before you can choose the proper control panel for any installation, you must understand the operating characteristics of control panels in order to ensure that the selected control safely and economically satisfies the requirements of the installation.

Standard multi-zoned control

This type of control has numerous zones individually wired to the control panel. Each wired zone (loop) monitors only those detection devices connected to it.

A typical, modern-day control will offer anywhere from 6 to 16 individually wired zones, including separate fire and panic circuits as a standard operating feature (in some cases, any zone can be programmed as a fire or panic circuit). In most cases, each zone can be programmed to operate and report separately from all other zones.

For instance, one particular loop can be wired to an entry/exit door. This loop would be programmed into the control as an entry/exit zone (zone type), and would function accordingly. The same can be done for loops that contain only perimeter sensors (burglary/perimeter), for loops that monitor interior sensors (interior zone), and for loops that connect only smoke detection devices (fire zone), etc.

All wired loops are given a zone-type classification, are wired to separate input terminals at the control, and react appropriately. The end user can activate (arm) or bypass specific areas, or zones, of a system at will. This makes zone identification at the system's console easier for the end user, and allows troubled zones to be temporarily bypassed, until serviced, while the rest of the system remains operative.

System supervision

One of the most important features offered by modern alarm controls is system supervision. Not only can all the protective loops be fully supervised from opens, shorts, and grounds, but the entire system can be constantly monitored for operational difficulties, such as ac power loss, undercharged back-up battery, Telco line failures, and other internal problems. Therefore, any condition that might later prevent a system from arming, reporting, or operating correctly, is immediately annunciated at the systems keypad, or reported to the central station.

Most modern controls supervise protective loops with an end-of-line resistor (EOLR). Any resistance change, above or below that which has been set up by the resistor, will trigger an alarm or give some sort of local annunciation. In many controls, this feature can be programmed out, in which case the loop operates as a standard series or parallel loop. Included on a typical control are the following power outputs.

Auxiliary power outputs

These auxiliary outputs supply power to smoke detectors, interior detectors, and other devices that require 12 volts to operate and are powered separately from contact loops. Most controls supply anywhere from 350 to 850 mA of power, which is available from the auxiliary outputs and remote outputs.

Remote power outputs

These supply power to the system's keypad(s), and in some cases to add-on zone-expansion modules.

Alarm outputs

These can be Form C relay outputs, which are used to supply power and operate devices that trip "on alarm." Any output classified as an alarm output will supply voltage when a system goes into alarm.

Speaker/bell outputs

These outputs supply power to trigger siren-drivers, power bells, trigger slave communicators, or to connect speakers to controls with built-in siren drivers.

Other control features include:

Self-contained siren driver

Today, many panels have their own built-in siren driver, which can supply a steady, sweeped, or pulsed output individually by zone. This eliminates the need for add-on units and makes speaker wiring a simple matter.

Self-contained communicator

Many controls have a built-in digital communicator that reports to a central monitoring station. These are usually compatible with all the major reporting formats and operate with rotary or touchtone frequencies, have line-seizure features that disconnect incoming and outgoing calls and disable call-waiting features, and work with interior lines that require an access number to dial through to an outside line. The communicator can be programmed to dial more than one telephone number should it fail to reach the first number and to report all types of system status information, such as burglary and fire alarms, zone trouble and restorals, opening and closing reports (for businesses), ac power loss, and other system problems. Self-contained communicators are an important feature since they eliminate the need for add-on (slave) units. If an installation does not require the communicator, it can remain dormant, and be activated at a later date.

Computer downloading

Many control panels are supplied with factory-installed modems that allow computer downloading/uploading through the telephone lines to a terminal located at the alarm company's main office. The savings realized from this new technology is shared by both the installation company and the customer. Installation costs are reduced significantly due to the fact that system programming does not have to be performed by installation personnel. The system can be installed and then programmed from the main office. Troubleshooting costs also are reduced. Problem areas can be quickly traced through terminal communications and sometimes be resolved without visiting the location. Other advantages are:

- changing arm/disarm codes at the customer's request
- communicating with customers through the keypad
- changing operational characteristics, etc.

Programming methods

Many controls give the installer/dealer three methods of programming:

- prom programming (from a programming unit)
- keypad programming
- downloading

These three choices make it possible for the novice as well as the seasoned professional to program an alarm system's entire operational and reporting functions.

Two-wire multiplexing

Some manufacturers produce a control that utilizes a two-wire "polling loop" to monitor and supply power to various protection points throughout the system. Instead of having 16 or more zones individually wired (home-runed) to the control, all the contact loops and space protection devices can be monitored, powered, and supervised from a basic 22-gauge, twisted-pair, two-wire loop that connects to the control. Not only does this simplify and cut down on installation time, it also allows for future expansion.

In a typical polling-loop configuration, a unit called a remote-point module (RPM) connects directly to the polling loop. Connected to the RPMs are contact loops (branches that monitor windows, doors, etc.), and space protection devices like passive-infrared detectors (PIRs) and smoke detectors. The polling loop constantly "polls" or monitors each RPM, receiving from it status information from each contact loop. When an RPM sees a contact-loop change (open, short, etc.) it transmits this information back to the control, which takes the appropriate action according to the definition of each protection point.

Each RPM is assigned a unique ID number (dip-switch-selectable) that allows the control to instantly identify which RPM is reporting and which contact loop is faulted.

The polling loop also acts as a power supplying circuit. It provides the voltage and current needed to operate space protection devices and other devices which require 12 volts to operate. Therefore, separate power runs from the control to these devices are eliminated, which allows the use of 2-wire devices. Figure 17-1 shows a diagram of a typical polling loop hookup.

Supervision

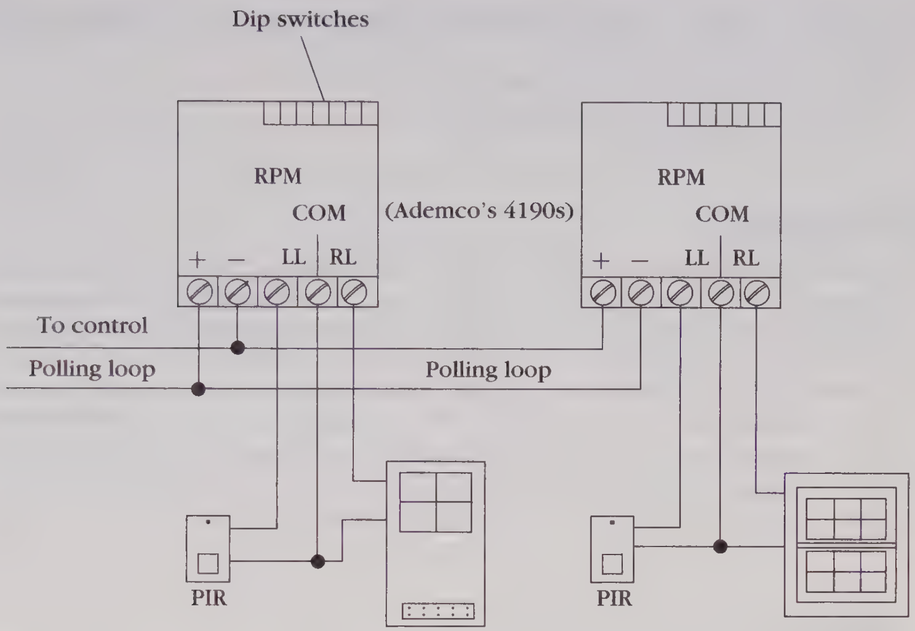
Controls that utilize a polling loop can be installed with what is known as a "class A" polling loop. By adding a special module at the control and returning the polling loop to this module, the loop can still be monitored even when there is an "open" in the loop. The control monitors the loop from both ends, thereby eliminating any bypassing of RPMs that might be located past an open in the main polling loop (Fig. 17-2).

EOLRs can also be installed at the end of each contact loop and operate on the same principle previously described. The explanation for power outputs, system supervision, and other features that apply to this type of control will not be repeated here.

When installing systems that use polling loops, take care when installing the polling loop and contact loops near intercom systems. These loops are extremely susceptible to audio interference. The loop wiring should be installed at least six inches away from intercom wiring. It is strongly suggested that you use shielded cable when working with polling loops.

WIRELESS CONTROLS AND RECEIVERS

Wireless controls, or control/receivers, use an ultra-high frequency (UHF) to transmit system status information. This eliminates the need to wire protective loops and



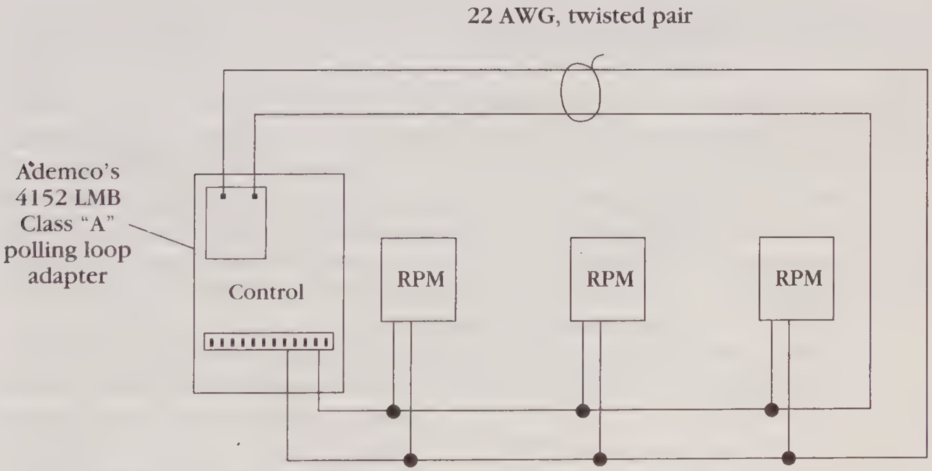
LL = Left loop/NC and/or no sensors

RL = For NC sensors only

17-1 A polling loop wiring configuration.

power supplying circuits to the control, which drastically cuts down on installation time and the possibility of wire-related faults.

To understand the operating characteristics of wireless controls, it is necessary to show how wireless alarm systems differ from conventional hard-wired systems,



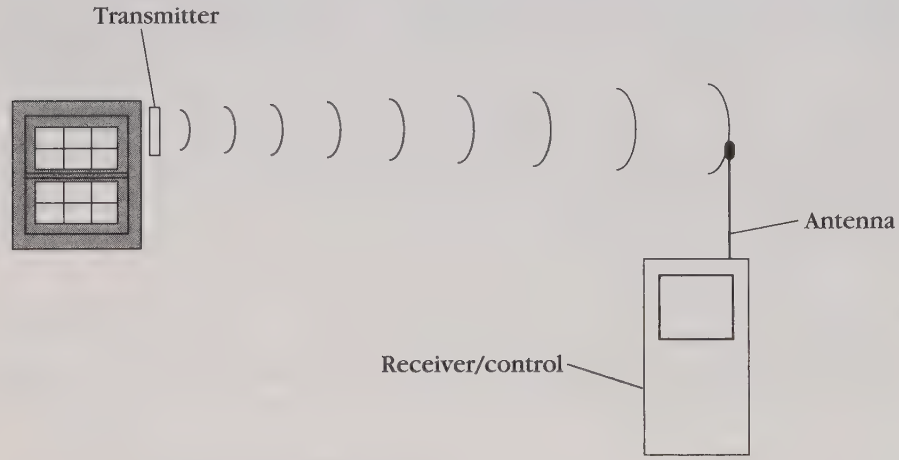
17-2 A class "A" polling loop configuration. The loop can be monitored from both ends.

in operation, supervision, and installation. The basic operation and make-up of a wireless alarm system is as follows:

- control/receiver (housed in one unit)
- battery-operated sensor/loop transmitters
- keypad wired/wireless

Basic operation

Protective loops are wired to battery-powered transmitters. These transmitters monitor the protective loops against opens, shorts, etc., and transmit this information using radio frequency (RF) signals, along with its own unique ID reporting number, back to the control/receiver. The control/receiver identifies each reporting transmitter, checks for its programmed zone type, then initiates the appropriate action. In wireless systems, interior detectors like PIRs and smoke detectors have their own built-in transmitters, which make them completely wireless (Fig. 17-3).



17-3 Wireless transmitter and receiver/control.

The main difference between hardwired and wireless controls is the increased possibility of RF interference. The location of the control/receiver is of paramount importance. Certain building materials like concrete and brick reduce the signal strength; metal blocks it completely. Electronic devices like VCRs, TVs, computers, and large metal objects like refrigerators, ranges, metal cabinets, and steel girders disturb transmission paths. Therefore, it is wise to place the unit at least 10 to 15 feet away from these objects. The same problem also applies to loop transmitters and the transmitters that are built into interior detectors.

The average range of wireless transmitters is typically a maximum of 200 feet, although transmission paths can be affected by building materials and other objects in the transmission path. To increase signal strength, all the transmission components of a wireless system should be carefully located.

Recently, some wireless controls have appeared that utilize a sensitive, superheterodyne receiver that has an increased immunity to RF frequency interference and is capable of pulling in weak signals (Ademco's Alert III 5700XR wireless alarm system).

Zoning capabilities

Wireless controls increase the flexibility of zoning configurations. To add more zones, you simply add more transmitters. For example, a wireless system like Ademco's Alert III can be configured to supply up to 63 individual zones, in any combination of door/window, smoke, or PIR transmitters. This eliminates the need for zone expansion modules that must be used with hardwired systems. Zoning requirements can be satisfied through the use of one control.

Supervision

Perhaps the most important aspect of wireless alarms is the presence of transmitter supervision. Obviously, if a transmitter is not working properly because of a low-battery condition, improperly set ID number, etc., status information from protective loops and interior detectors cannot be transmitted back to the control.

A good wireless system should supervise all the system's transmitters by receiving timed interval "check-in" signals from each transmitter. They should also warn in advance of a low-battery condition. Ademco's Alert III low-battery warning will give a user up to 30 days to replace the battery before the transmitter shuts down completely.

Wireless controls now come with built-in siren drivers and provisions for hooking up digital communicators. The standard control power outputs are also included, along with internal supervision, which allows these types of controls to rival their hardwired counterparts.

Although the amount of wiring to the control is reduced significantly, some components, like sounding devices and some keypads, still need to be hardwired. Most wireless controls also offer at least one hardwired zone input. Some manufacturers are now producing wireless controls that use wireless keypads.

With technology increasing at a rapid rate in the wireless field, we might soon see the advent of wireless sirens and speakers, giving new meaning to the phrase "wireless."

Combination controls

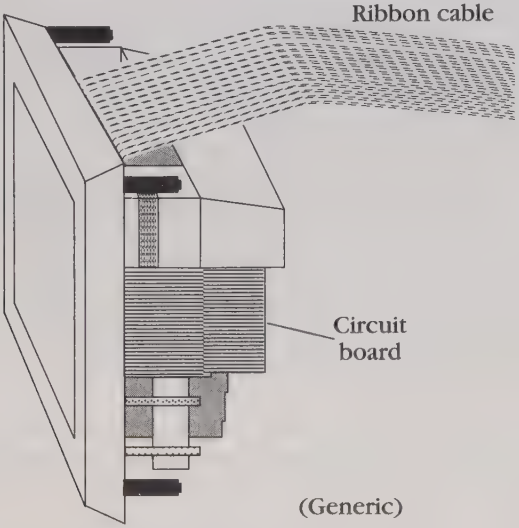
Combination controls offer the technology needed to use either hardwired/multiplexing/wireless, or any combination of the three from one control. The convenience of these controls is obvious. You can stock one control that will solve most installation needs. An area of an installation that poses wire routing problems can quickly be accommodated with the control's wireless feature.

One of the leaders in this technological breakthrough is Ademco, which produces a line of combination controls that utilize all three methods. The VISTA XM and the VISTA XMP make it possible to monitor up to 64 protection zones with up to 16 2-wire smoke detectors. With a built-in-communicator, downloading, and outputs for driving sounding devices, one system can easily satisfy the most difficult installation and offer fast and logical alternatives for future expansion.

SELF-CONTAINED CONTROLS

Some installations might not require a separate keypad at a remote site far from where the control is located. For these installations, use a self-contained control that houses the keypad and control in one compact unit. These controls are commonly used for smaller type installations that require only one or two zones. They are perfect for small apartments and small offices.

Some self-contained controls can be used as a complete security system, or as an area-arm module to partition off one or two zones of a larger system. The partitioned portion can then be separately armed and disarmed with a different code. These systems are perfect for adjoining businesses that "share" the same main control, but remain independent from it in operation. Figure 17-4 shows an illustration of a self-contained control.



17-4
A self-contained control.

As you can see, there are many types of control panels. Each has its own operating characteristics. Most contain the same basic functions and features, while some offer options not available on others. It would be unreasonable to assume that one should be familiar with all the different types. I have provided a general overview of the different controls available, so you can get a basic feel for what is available. Once you have a general understanding of how to wire devices and protective loops to controls, how to determine the proper power requirements, how to use voltage outputs, relays, etc., choosing the proper control for any application will be easier.

One of the best ways to familiarize yourself with a manufacturer's controls is to acquire a collection or binder of their installation manuals. NAPCO Security Systems in Amityville, NY, makes available for $14.95 a collection of all their installation manuals for their entire control panel line.

Ademco also has a huge three-volume installation and troubleshooting manual that is an excellent research source. They also offer, for $5, a 150-page technical manual that explains in full detail the installation and operating procedures for their current combination (VISTA) controls. Other companies like Sentrol in Portland, OR, publish an installation manual called *Application Notes* that gives excellent tips for installing magnetic contacts and other protective devices. They also have video tapes available for the same purpose.

CHOOSING A CONTROL

Choosing the proper control should be done only after the installation requirements have been established. Although many manufacturers offer 16-zoned panels, a 6-zone or an 8-zone might be more than adequate for a smaller installation (Fig. 17-5).

Following some of these simple guidelines will make the selection of controls easier and allow you to focus on two or three units that will satisfy most of your installation requirements.

1. How many zones are required: 2, 4, 6, 8, 16 or more?
2. Will the system be hardwired, wireless, multiplexed, or a combination of the three?
3. Is a digital communicator required?
4. What are the power requirements: 350 mA, 650, 800, or more?
5. Will smoke detectors be used? If so, how many detectors can the control (as standard) support?
6. Can the system perform the required bypassing features?
7. Will the system be keypad programmed, prom programmed, or downloaded?

PROTECTIVE LOOPS

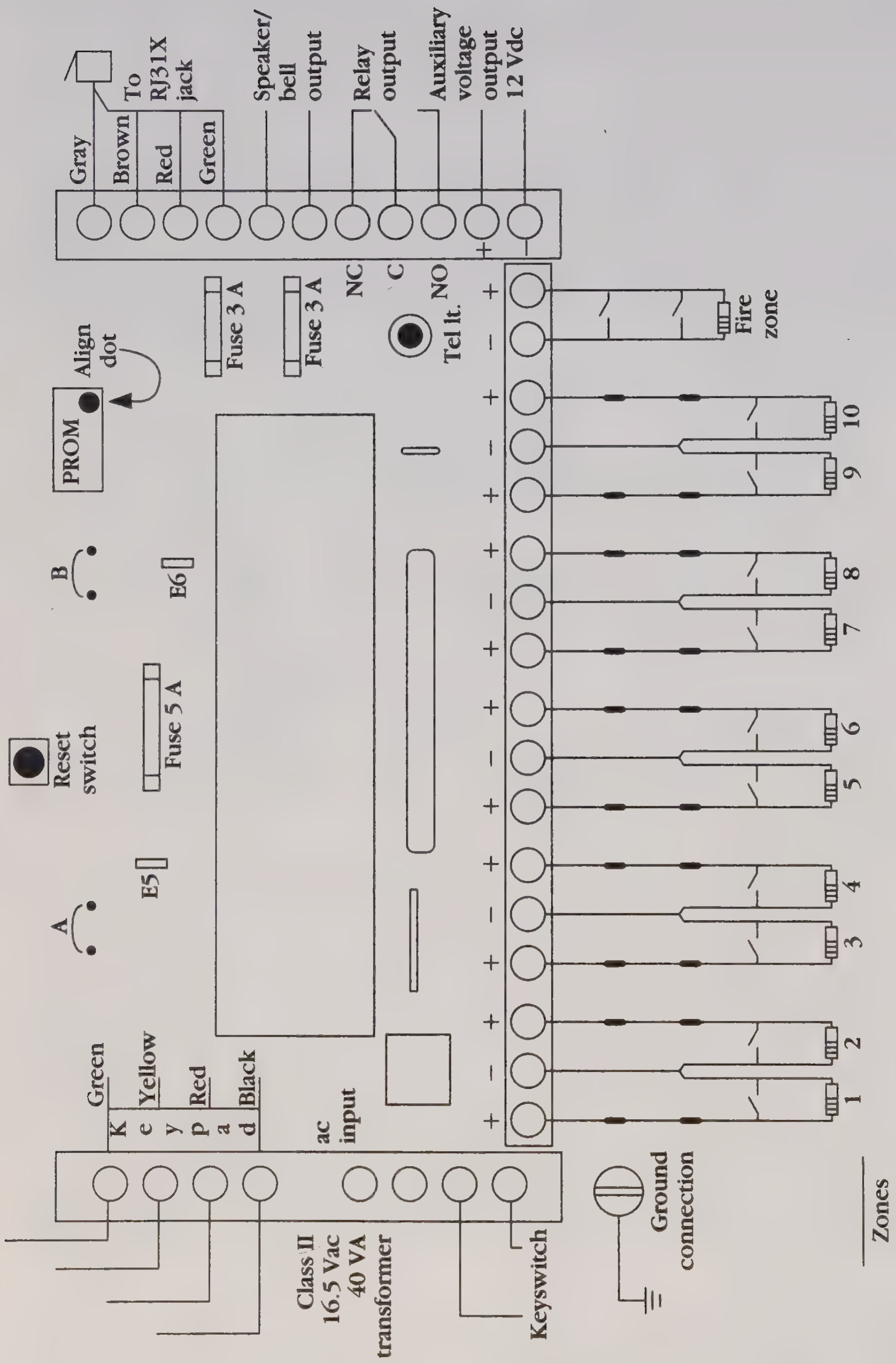
In the past, many types of protective loops have been used in alarm systems. Many of these loops are no longer used because they offer inferior line supervision compared to today's fully supervised loops.

Modern systems use simple two-conductor loops that have the ability to incorporate the principal operation of both series and parallel circuits. These loops are fully supervised and offer better protection from opens, shorts, and grounds.

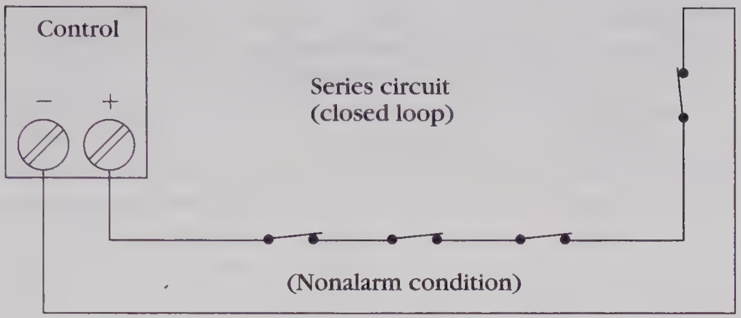
There are two basic types of protective loops in alarm systems with which you will work: the closed loop, also known as a series circuit, and an open loop, also known as a parallel circuit. Again, today's modern alarm systems allow for the use of both types of devices, on one simple two-conductor loop. This is accomplished by an EOLR that is placed in series at the end of the loop farthest from the control.

EOLRs have played a major role in the elimination of various types of loops, which were previously the only way to establish 100-percent supervised circuits. For this reason, I will only discuss closed and open loops. First let's look at how closed and open loops without EOLRs are installed. You will see the advantages and disadvantages of each type of loop. Then I will show you these same loops installed with EOLRs. This way you can understand how the EOLR creates a more effective supervised circuit.

In Fig. 17-6 a two-conductor loop is wired from switch to switch and ended at the last switch. Each switch in a series circuit is normally closed when next to its magnet, therefore the current has one direct path to travel: from negative to positive. Because each switch is closed, the current is supplied with an uninterrupted flow path.

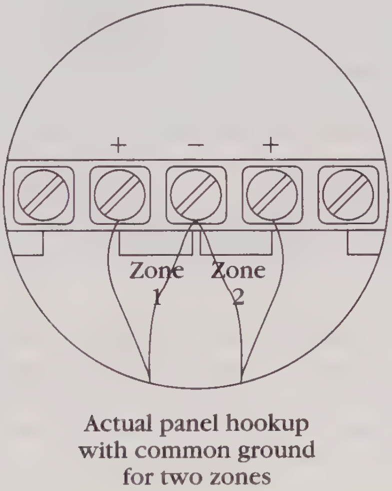


17-5 A typical control schematic.



17-6 A series circuit showing no openings.

Figure 17-7 shows how each end of the two-conductor pair is connected to the positive and negative terminals of each zone's input. One wire of the twisted pair (brass) is connected to both terminals of each switch. The other wire (silver) is run alongside the brass and not connected to any switch, except the last one. This switch is considered the furthest (end) point in the loop.

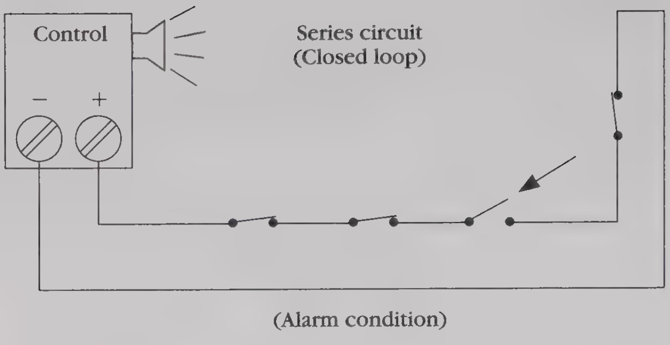


17-7
Panel hook-up example for two loops.

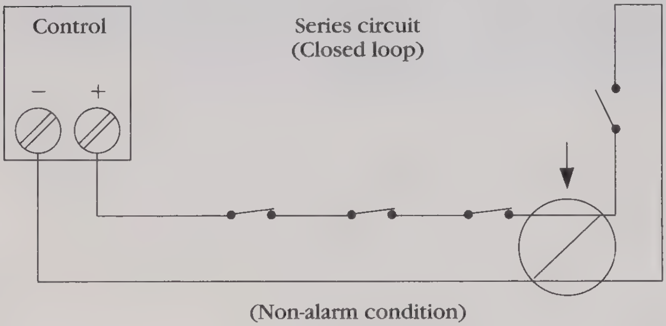
Note: In a series circuit always keep all the switches wired on one side (positive) of the loop.

In Fig. 17-8, a switch has been opened and the current flow has been interrupted. Current cannot return to the control, which will cause an alarm to sound. Here you see the basic and fundamental operation of a series circuit. **Advantage:** This type of loop is **supervised** against opens. **Disadvantage:** This type of loop is **not supervised** against shorts or grounds (Fig. 17-9).

A short, intentional or otherwise, gives the current a shorter path back to the control. **Current will always take the shortest route possible.** Therefore, any opened switch beyond the short will **not** cause an alarm. The rest of the loop beyond the short will have been successfully bypassed.

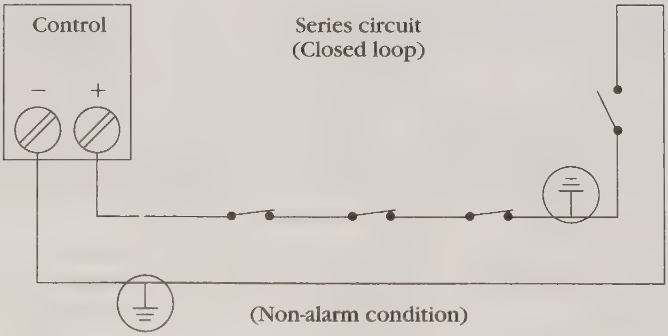


17-8 Shows a contact switch opened, breaking the circuit and initiating an alarm.



17-9 A short across the negative and positive legs of the loop prevents an alarm condition when any contact after the short is opened in a series circuit.

Another problem that can occur in any kind of loop is an accidental ground. A ground is a portion of exposed wire that comes in contact with a grounded part of the building. It is practically the same thing as a short. Instead of the circuit being completed to ground at the control, it finds an alternative ground. This condition causes no alarm in a series circuit. Figure 17-10 shows this condition.

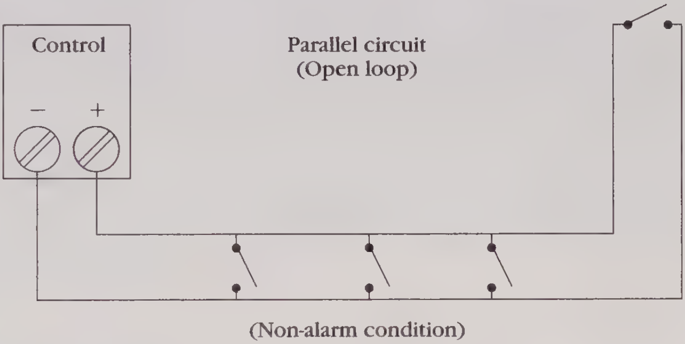


17-10 A ground on the negative and positive legs.

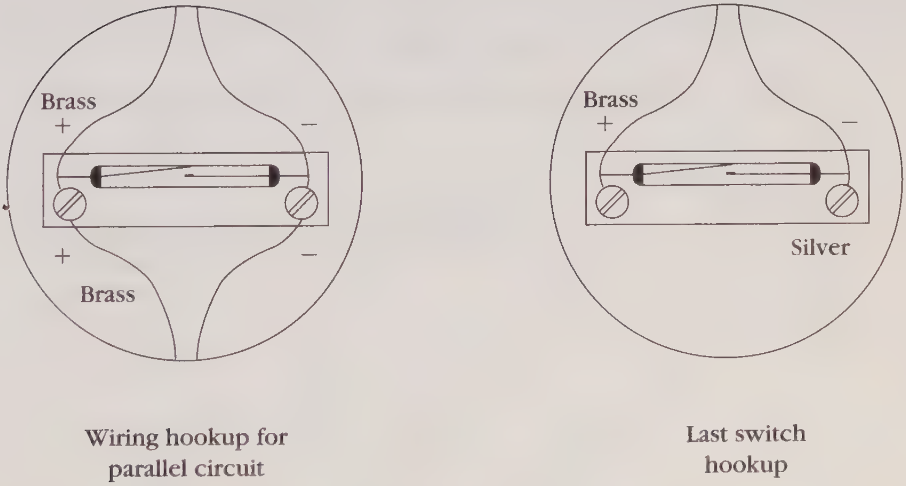
An accidental ground on one side of the loop, or a ground on both sides of the loop, will give no alarm condition. However, any switches between the two grounded portions of the loop might be easily bypassed. Two grounds on one side of the circuit will also bypass any switches between the two grounds.

In Fig. 17-11, both wires of a two-conductor loop are wired to each normally open switch (when next to its accompanying magnet) and end at the last switch. Unlike the series circuit, current cannot flow back to the control because there is no continuous unbroken path.

In Fig. 17-12, a two-conductor loop is wired to each terminal of a normally open (NO) switch and ends at the last switch. Unlike the series circuit, current cannot flow back to the control because there is no continuous unbroken path. One wire of the two-conductor loop is connected to one terminal of the switch, and the other wire to the other terminal. This connection is repeated from switch to switch.



17-11 A parallel circuit in the nonalarm condition.



17-12 A negative to negative, positive to positive hook-up, and how to hook up the last switch.

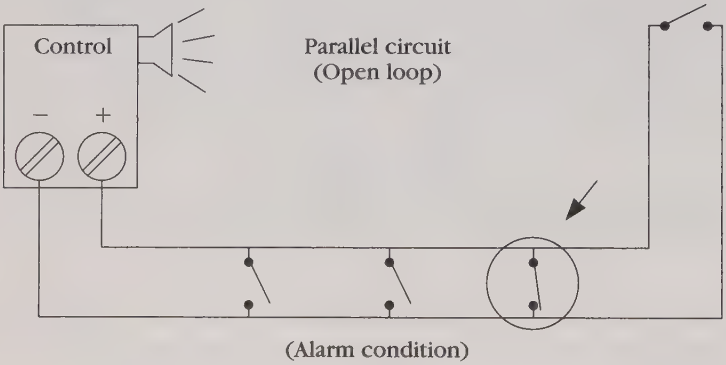
When a switch is closed in a parallel circuit, as shown in Fig. 17-13, current now has a continuous unbroken path to flow. This will cause an alarm to sound. **Advantage:** This type of loop is **supervised** against shorts (closings). A short anywhere across both sides of the loop will cause an alarm. **Disadvantage:** This type of loop **does not supervise** against opens.

For example, in Fig. 17-14 a portion of the wire has been broken (cut, split, etc.) causing a break or open in the loop. A switch closed anywhere beyond the break will not cause an alarm condition. The loop portion beyond the break has been successfully bypassed. Current does not have a continuous unbroken flow path.

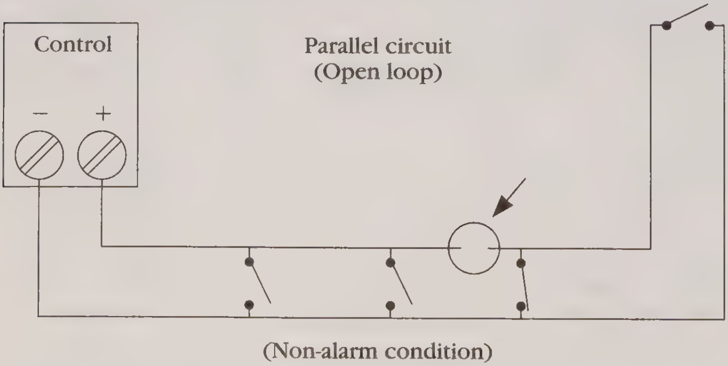
An accidental ground on both sides of the circuit, as shown in Fig. 17-15, will cause a short that will create an alarm condition.

You can see that both these types of loops have advantages and disadvantages. Although the series circuit gives better line supervision than the parallel circuit because it offers protection from opens, it still does not offer protection from shorts.

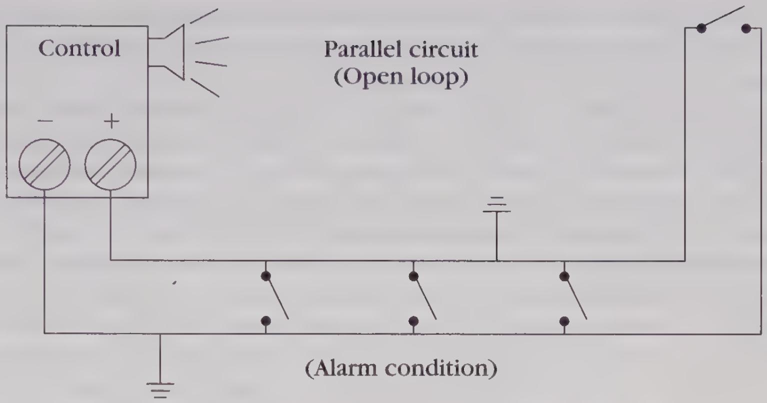
To create fully supervised circuits in both kinds of loops, double-closed loops were used extensively in the past. Although I will not go into the operation of a double-closed loop extensively, you should be aware of it because you might run into it on a previously installed system.



17-13 A normally open switch closed, tripping an alarm in a parallel circuit.



17-14 An open (break in the line) in a parallel circuit.

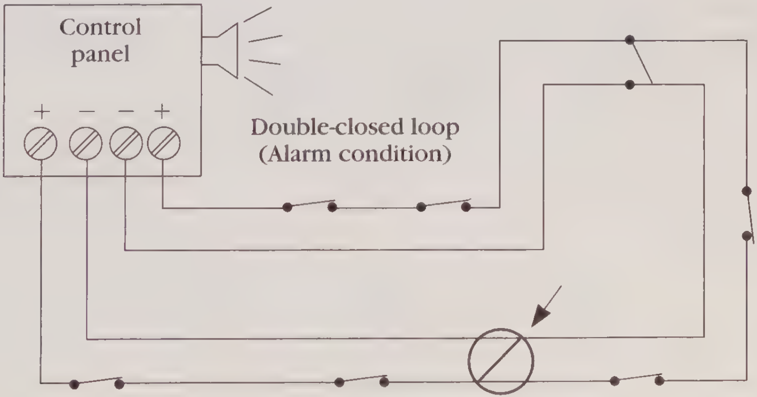


17-15 Grounds on both legs of a parallel circuit.

In Fig. 17-16, a 2-wire loop is returned to the control panel. On this type of loop true positive and negative polarity is established. Note how closed circuit devices are placed on the positive side of the circuit. This type of loop will allow for the use of open circuit devices. A short occurring anywhere across the positive and negative wires of the loop will trip an alarm. An open anywhere in the circuit wires will trip an alarm. Grounds on both wires will also trip an alarm. This type of loop is more time-consuming to install because the loop must be returned back to the control. This is sometimes called a 4-wire loop.

Loops with EOLR

In the past, EOLRs have been incorporated into open and closed loops to provide complete line supervision against shorts and opens. They also allow closed circuit devices to be used in conjunction with open circuit devices, thereby creating a



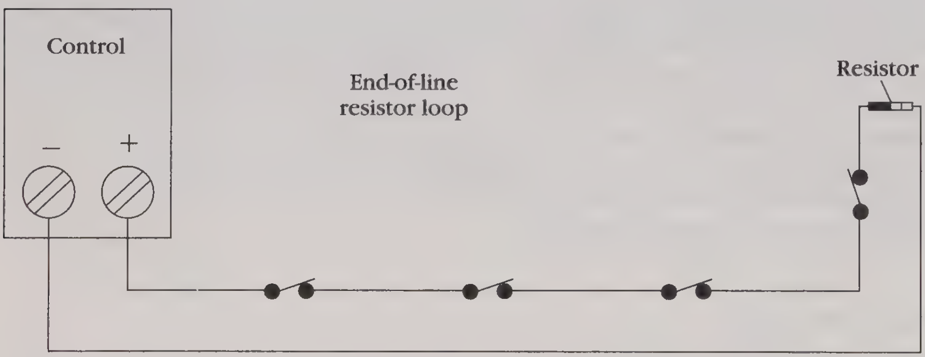
17-16 A double-closed loop and a short occurring between the positive and negative legs. This will cause an alarm condition.

combination of the two circuits on one basic two-conductor loop. Not only does this set up total line supervision, but it also avoids having to install a double-closed loop.

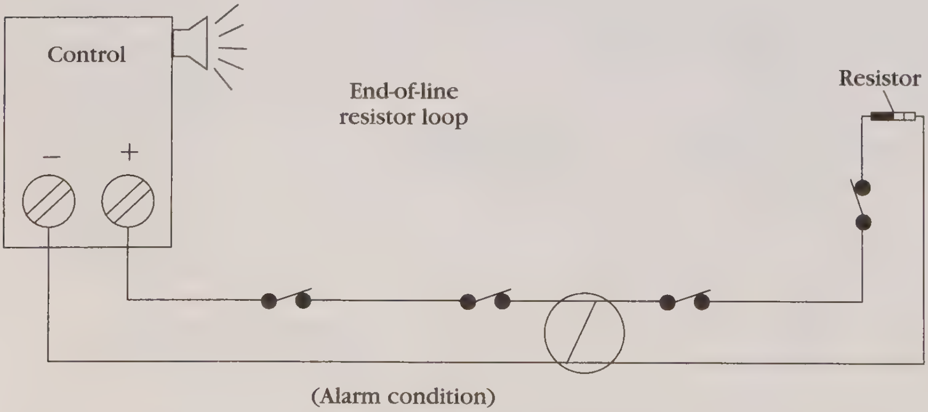
In an EOLR loop, the control is designed to look for or "see" a specified resistance value on a secure loop. If that resistance value is changed (within allowable tolerances) the control will detect the change and trigger an alarm. Different manufacturers use different resistance values. For instance one manufacturer's control might look for 2,200 ohms of resistance on a loop, while another's might look for only 1,000 ohms of resistance. It is important to check and work with only those values stated by the manufacturer for that specific control.

Figure 17-17 shows how an EOLR is installed at the furthest point of the loop. The control now sees a specified amount of resistance in the loop when all the switches are closed. This loop will allow the system to be set up properly.

In Fig. 17-18, you can see how the EOLR placed at the furthest point of the loop sets up line supervision. A short, occurring anywhere along the loop, will cause cur-



17-17 An end-of-line resistor (EOLR) loop. This shows the resistor being placed at the end of the loop (after the last contact).



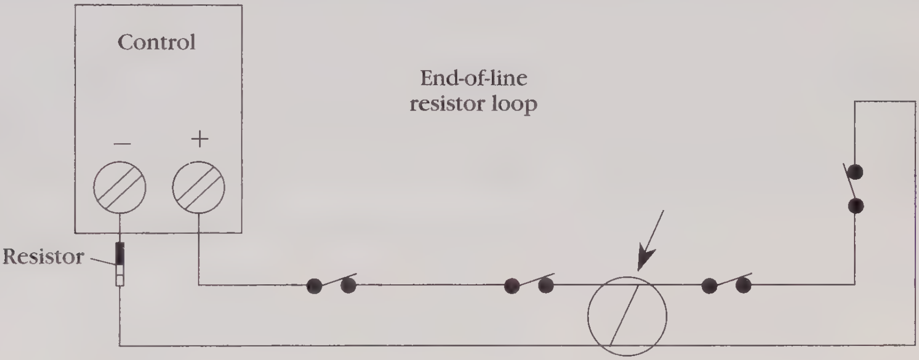
17-18 A short between the positive and negative legs anywhere before the EOLR will cause an alarm condition.

rent to bypass the resistance value of the EOLR. The control will detect this loss of resistance and sound an alarm. **The EOLR has supervised against a short.** In an EOLR loop, the opening of a normally closed switch will operate as previously described and trigger an alarm.

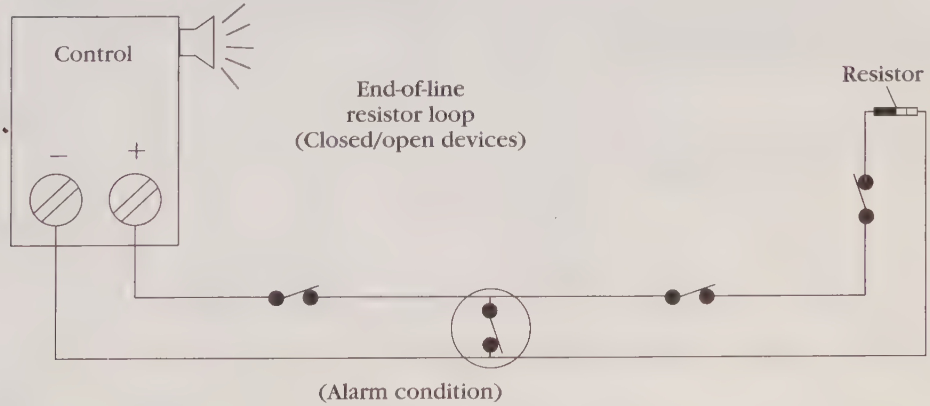
Installing the EOLR near the control, as shown in Fig. 17-19, will still allow the circuit to operate, but will remove the supervisory feature of the EOLR. Here a short across both wires will go undetected because the resistance value has not been removed. The opening of the switch located beyond the short (or any switches beyond the short) will be bypassed by the short. **Always install the EOLR at the furthest point of thé loop.**

In this circuit, which provides normally closed and normally open devices, the closing of the normally open device will remove (short-out) the resistance value set up by the EOLR and an alarm will occur (Fig. 17-20).

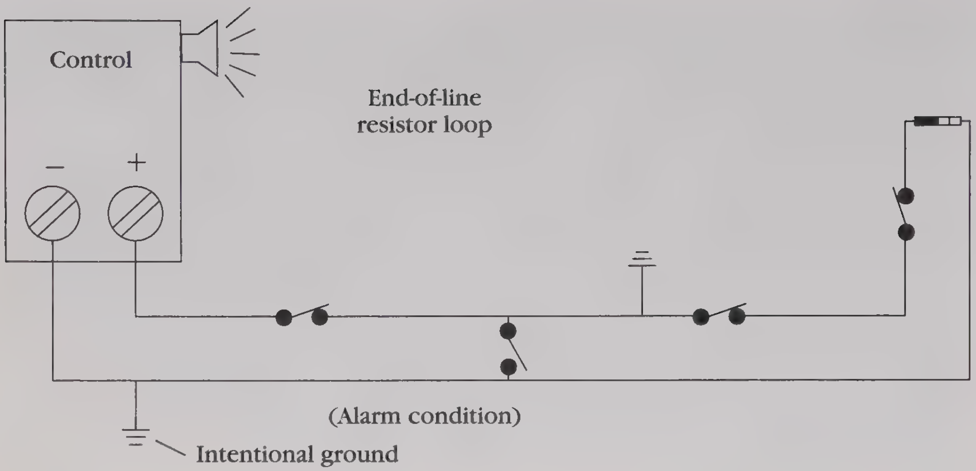
As shown in Fig. 17-21, EOLR loops also give accidental ground protection. A ground on both sides of the loop will create an alarm condition.



17-19 Placing the end-of-line resistor at the control will defeat its purpose. Here a short will go undetected.



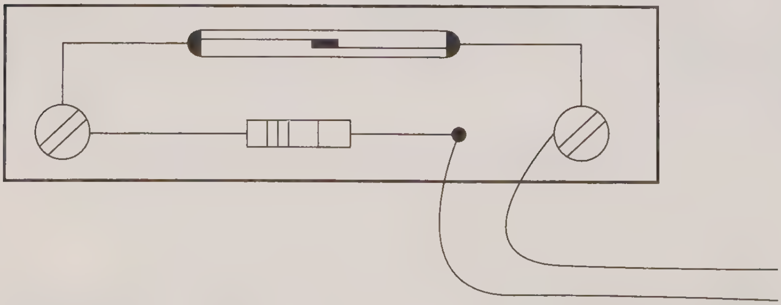
17-20 Shows how normally open and normally closed devices can both be used on an EOLR loop.



17-21 Grounds in an end-of-line resistor loop will set off an alarm condition.

Most modern controls today have the negative side of the zone's input internally grounded. This way a ground on the positive side will give an immediate alarm. This protects against two grounds occurring on the positive side of the circuit, which might allow for the bypassing of any switch between the two grounds. There are various ways to install an EOLR:

1. You can physically solder it into the loop right after the last switch or inside the last switch.
2. Connect one end of the loop to one terminal of the switch.
3. Solder the other end of the loop to one end of the resistor.
4. Connect the EOLR to the other terminal of the switch. (Resistor will be hidden when switch cover is on and easily accessible for servicing, as shown in Fig. 17-22.)
5. You can install EOLR switches. Some alarm manufacturers now have magnetic contacts with built-in EOLRs. Although these contacts are twice the cost of regular contacts, they do save time and are only needed at the end of the loop.



17-22 Shows how to install an end-of-line resistor inside a magnetic contact's cover.

RELAYS

In alarm work you most likely, at one time or another, will have to work with a relay. Although the use of relays in alarm systems has diminished significantly due to the availability of sophisticated micro-computerized controls, you should be familiar with the basic operation of relays because most modern controls have one or two built-in relays.

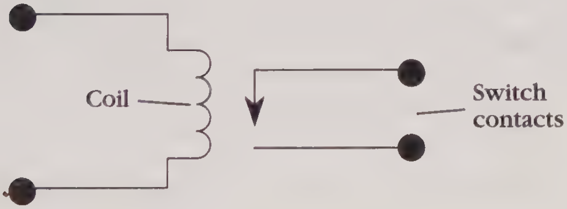
A relay is nothing more than an automatic, electromagnetic switch. A relay consists of two parts, a coil and a magnetic switch. When an electrical current flows through the coil it creates a magnetic field around it. This magnetic field will be proportional to the amount of current flowing through the coil. At some specific point the magnetic field will be strong enough to throw, or trip the switch, which causes it to change its state to make or break a circuit.

Often, you might have a circuit that must be switched on when the voltage or current in another circuit rises to some specified level. For instance, you might want a strobe light to go on when the alarm system is tripped and stay on even after the sounding device has timed off and the system has reset itself. This serves as a visual annunciator to anyone entering an empty premises that an alarm has occurred.

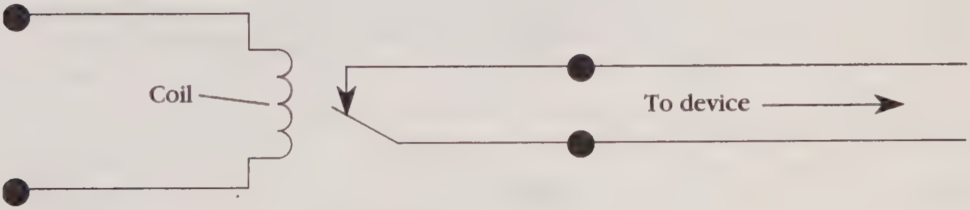
The simplest type of relay is shown in Fig. 17-23. This figure shows a single-pole-single-throw (SPST), or Form A, relay. This relay is considered NO when no voltage is applied thorough the coil.

As shown in Fig. 17-24, when voltage passes through the coil, the switch contacts automatically close and complete the circuit. When voltage is removed, the contacts return to the NO position and break the circuit.

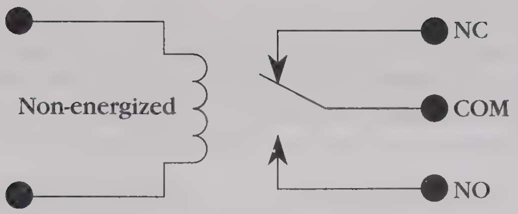
Another type of relay more commonly built into today's modern controls is the single-pole-double-throw (SPDT), or Form C, relay shown in Fig. 17-25. This relay has a common point, a normally closed (NC) point, and an NO point. When the relay is de-energized it remains in the NC position.



17-23 A single-pole-single-throw relay.



17-24 With the coil energized the relay will close.



17-25 A single-pole-double-throw relay de-energized.

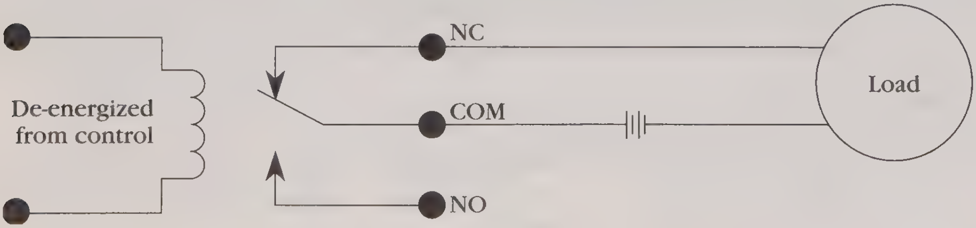
In Fig. 17-26, the circuit to the load is completed through the relay. The load has a power supply separate from the control. The load could be a door strike or a magnetic lock that remains closed at all times.

When the relay is energized, as shown in Fig. 17-27, the contact switches to the NO position and removes power to the load and releases the door strike or magnetic lock.

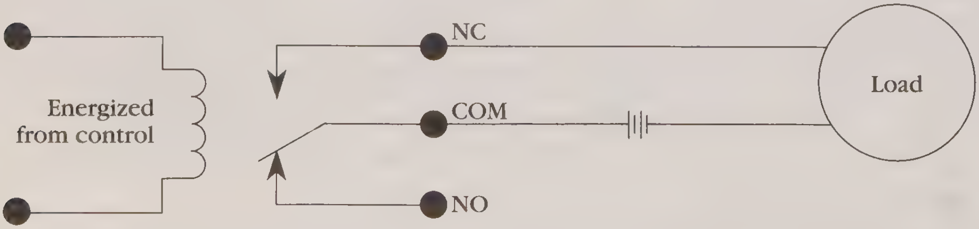
How a device is wired to a relay (in the case of a Form C relay) dictates what type of function the relay performs. For example, the load in Fig. 17-26 could have been wired to the NO terminal of the relay. In that situation the load would receive power (be activated) once the relay coil was energized. This type of hook-up can be used to control door access equipment. By using a special access code, the door egress can be controlled from the system's keypad.

Latching relays

A standard relay will switch when energized, then switch back to its original state when the power is cut off. This type of relay is used when a temporary change or function is needed. Latching relays will switch when energized, but will not change back to their previous state when power is cut off.

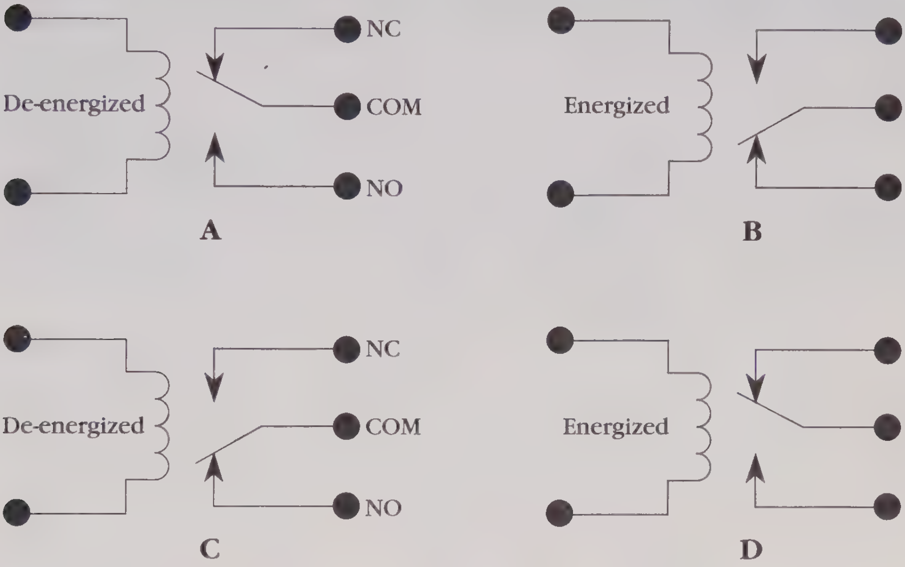


17-26 A separate power supply other than from the control being used to supply power to the load.



17-27 Power is removed from the load when the relay is energized and tripped.

In Fig. 17-28, (A) shows an SPDT relay in the NC position when de-energized. As the coil of the relay is energized (B), the contacts switch to the NO position. When the coil is then de-energized, the contacts remain in the NO position, or latched (C). When the coil is again energized, the contacts will switch back to the NC position and remain latched there when the coil is de-energized.



17-28 An SPDT relay in the various positions.

Ratings

When you add a relay to a circuit, the voltage and contact ratings are important to ensure that the relay operates properly.

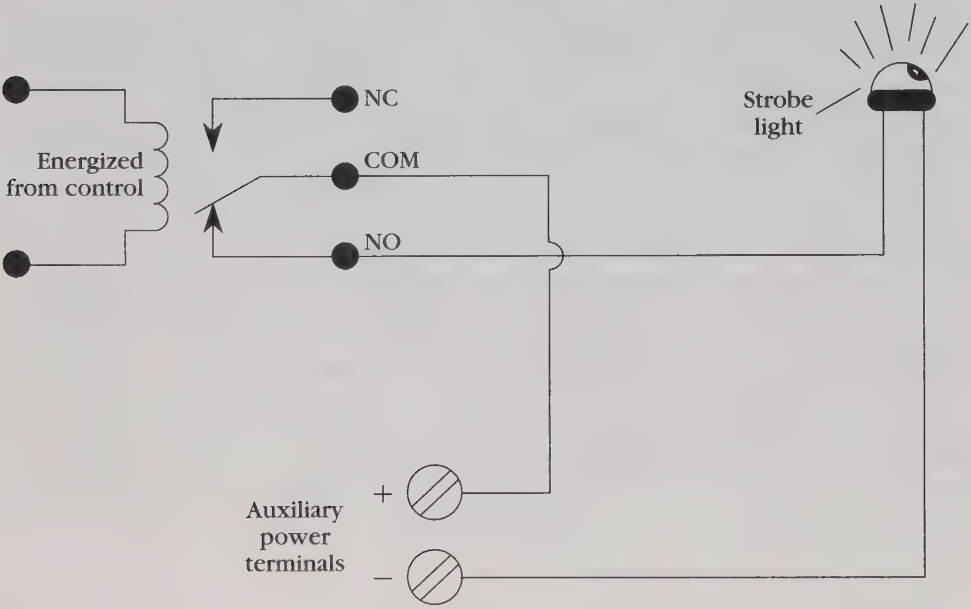
The controlling voltage through a relay coil should not be more than +25 percent of the rated value or damage might occur to the coil. On the other hand, a relay rated to operate at 12 volts can be connected to a 6-volt circuit, but probably would not operate very well, and would be inefficient.

Contact ratings in a relay are manufactured to handle a specific current load. Too high a current might damage the contacts, either by "welding" together the contact points or creating resistance in the contacts (from the constant arcing), which could lead to a blockage of current flow through the points. Always be sure that the voltage and current ratings of a relay are compatible with the circuit on which it will be used.

Relay output

On many of today's modern controls you might see the term *relay output* or (*Alarm output*) used to define a control-supplied relay. These relays are of the Form C type, and are used to supply 12 volts to operate additional devices, or as *dry contacts* to switch on or off externally powered devices. These outputs can be programmed to operate for specific time intervals and trip when an alarm sounds, for a specific duration, or latch until the system is manually reset.

Figure 17-29 shows how a strobe light can be wired to a control-supplied relay to draw its operating power. This relay would be programmed to latch on once an alarm is tripped. This allows the strobe light to remain on even after the system had timed-out (reset itself).



17-29 Wiring configuration showing how an SPDT relay can be used to trip a strobe light when a specific condition occurs.

Tools and test meters

Not having the right tool to do a specific job can turn an easy job into a nightmare. It can also tie up a lot of other work that must be performed afterwards. You cannot expect to troubleshoot an alarm system if you've left your test meter back at the shop, any more than you can strip a whole bundle of loop wires if you do not own a wire stripper.

Although certain jobs demand certain tools, common sense should tell you that a wide variety of all purpose tools will allow you to be prepared for almost anything. Before you spend hundreds of dollars on every new gimmick tool being pushed in your face, be sure that your tool box is well stocked with general, hand, and power tools:

- screwdrivers: straight, phillips, stubbies, offset
- pliers, wrenches, wire strippers, cutters
- vise-grips, metal hole saws, wood spade bits
- cordless drill, electric drill

- drill bits, standard high-speed, carbide
- hammers, center punches, chisels, extension cords
- tape measure, pry bar, nail-pullers, nut-drivers
- utility knives, sheetrock saw, hacksaw, panel cutters
- flashlight, ladder, stud finder, pocket level

Keep in mind that you will be working with common building materials from time to time, such as wood paneling, sheetrock, metal, plaster, lathe, cement, wood, etc., so be sure to have a variety of the appropriate tools handy for working with these materials.

SPECIALIZED ALARM TOOLS

As in any profession, the type of work you do will demand a specialized set of tools. Trying to perform certain jobs without these tools can make an easy job extremely hard, if not impossible. The following is a basic summary and explanation of the various alarm installation tools used by many installers today.

Flexible drill bits

Labor $aving Devices of Lakewood, CO, makes flexible-shaft drill bits that are extremely handy for drilling holes into the sole and top plates of interior and exterior walls, firestops, and other areas which would be otherwise impossible to get to with regular drill bits. The Spearzit, made by this company, is a flexible-shaft drill bit that starts and drills at any angle. It is designed to avoid "walking" or skipping on wood, and is available in a variety of varying lengths and diameters. The tool is extremely popular with installers because it allows the round spring steel shafts of these bits to be bowed in any direction. The Spearzit is available in ¼-, ⅜-, and ½-inch diameters, and in lengths from 6 to 72 inches.

Wire-pulling tools

Like a ratchet is to an auto-mechanic, a wire-pulling tool is to an alarm installer. Pulling wire through walls is the mundane and thankless part of alarm installation. (I shouldn't say thank-less, because if all the wire gets through without being damaged you will be thanking someone.) There are a variety of tools you can purchase to make the job of pulling wire through walls easier and quicker. Although the standard spring steel wire snake can still be used in uninsulated walls, there are quite a few tools that can quickly and professionally help you get through insulation-filled walls, under carpets, across acoustical ceilings, up into attics (without putting a hole in the roof), and other inaccessible or hard to work with areas. The time and money these tools will save you each and every day will be well worth the cost of the tools.

Figure 17-30 shows an electronic stud sensor, sold by Labor $aving Devices. It is used to find metal or wooden studs (not nails as it checks density). This tool can be used with the tool in Fig. 17-31, which is called "the Wet Noodle and Retriever," and is also sold by Labor $aving Devices. This tool takes advantage of the open space at the sides of the stud where the insulation is stapled (there is usually a gap there).

Electronic stud sensor
- Finds the stud **not** the nail
- Pinpoints each side of the stud
- Locates wood and metal studs
- Powered by 9-V battery (not included)

17-30 This tool is perfect for finding wooden studs in plaster or sheetrock walls.

17-31 A wire-pulling tool. Excellent for use in plaster-lathe walls; eliminates lattice snagging of wire snakes. Labor $aving Devices

1. Drill a hole at the side of the stud and insert the ball chain. Let it sift its way to the bottom.
2. Drill another ¼-inch hole at the bottom on the side of the stud behind or two inches up from the bottom of the baseboard.
3. Insert the flexible 24-inch handle into the hole. This tool has a magnet on the end of it that will attract the ball chain and grab on to it.
4. Pull the ball chain out with the handle and then attach your wire to the ball chain. Now you can pull your wire back up through the top hole. This ball chain is made of high quality steel for strong pulling power so you will not have to worry about the chain breaking.

The tool in Fig. 17-32 is called the Creep-zit. This tool can solve many installation problems where a conventional wire snake will get snagged-up. Some of the possible applications for this tool are:

1. Grid ceilings and crawl spaces with no access area.
2. Insulated walls and wood-lathe filled walls.
3. Running wire under carpets. (The small channel between the tack strip and the wall is an excellent place to hide wire, like when a loop must be brought from one window to another.)

This versatile tool ~~can~~ handle all of the above problems and almost eliminate future use of conventional "fish tapes." It consists of five 6-foot-long rods that can be used separately or screwed together to make 30 feet. These rods are fluorescent green in color, made of fiberglass, and are less than 3⁄16 inch in diameter.

Two unique heads are included for multiple methods to fish wire. The first head is a wisp-like (egg-beater type) head. These rods are very flexible and, with the wisp-

17-32 One of the most common and popular tools for fishing wire through the hardest to get through places. Labor $aving Devices

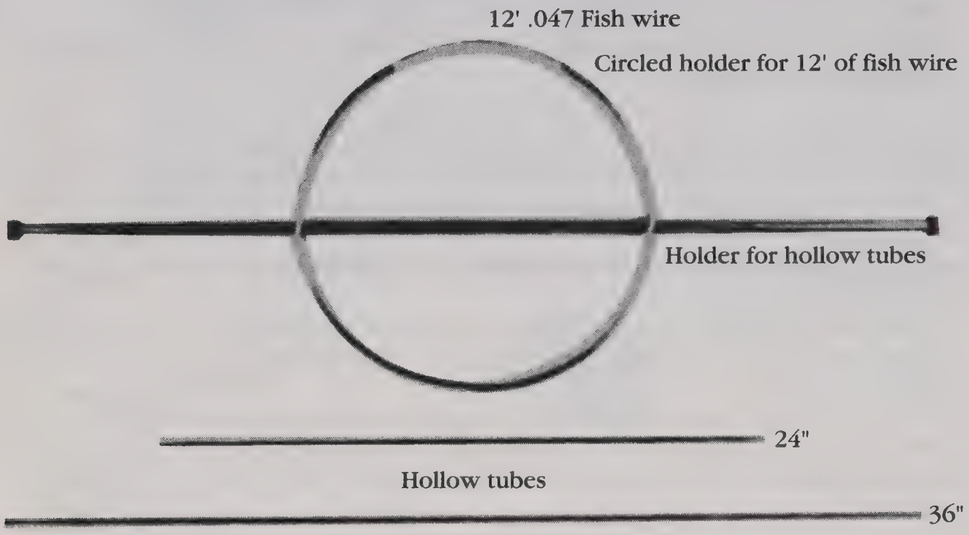
head attachment, literally crawl over impossible places. If it gets hung up, give the rod a flip, and it will jump out of its situation. By turning the rod, the wisp head will walk like a caterpillar, so you can guide it where you want it to go, unlike a conventional snake wire, which goes where it pleases. The rods, when screwed together, are so flexible that when they are given a flip they can jump over air conditioning ducts or any other objects in the way.

The head attachments are bull-nosed shaped, which prevents them from getting snagged up on insulation and allows them to glide smoothly through walls and wooden tack strips.

The tool in Fig. 17-33 is perfect for fishing wire *under* carpets. Sometimes the only alternative for getting wire from one side of the room to another is from under the carpet. However, when you fish wire under the carpet you should slide the wire between the rug and the padding. This will cushion the wire and protect it from being split or smashed. You should also use a heavily-jacketed wire (twisted-pair only, never solid). Avoid running the wire near doorways as these areas receive lots of foot pressure. Try to run the wire under carpets where it will have the least amount of pressure applied. This under-carpet fish tape is made of stainless steel and has rounded edges to prevent hang-ups.

17-33 An under-carpet fish tape; excellent for sliding wire under carpeting. Labor $aving Devices

The "Attic Fishing Tool," shown in Fig. 17-34, was designed for the "attic man." That's the guy who is at the low-end of the totem-pole and who has the daily pleasure of crawling over attic-floor insulation. If you've ever had to do this on a hot summer's day, it's an experience you won't soon forget (scratch! scratch!).



17-34 A perfect tool for fishing wire from a second floor window header up to the attic. Labor $aving Devices

When you have to drill from the top of a window into the attic, you will encounter one major hazard: trying not to drill through the roof! The space between the exterior wall's top plate and the roof sheathing is small. This job usually requires two people: one person drills up to the attic and stops when the other person, who is laying down on insulation in that hot, tight attic, tells him or her to stop. Then the wire either gets fished up or down through the hole. It's not a fun job!

The Fish-eze by Labor $aving Devices contains two high-quality hollow stainless steel tubes (24 inches and 36 inches long) that store in a durable container. A round stainless steel holder contains a 12-foot specially plated spring wire with eyelet loops at each end. This wire is double heat-treated to keep a coiled effect. To use this tool:

1. Drill a ¼-inch hole to the attic, then pull the drill bit back out from the hole.
2. Insert one of the tubes up into the hole, and stop when you hit the roof sheathing. Pull the tube back down a few inches.
3. Insert the spring wire into the tube and push up into attic. The spring wire will coil out of the tube.
4. Pull the tube out of the hole and then attach the wire to the end of the spring wire at the window.
5. Have your partner (or go up and do it yourself, ugh!) from the center of the attic, grab onto the coiled spring wire with a telescoping pole and pull the spring wire and loop wire up through the hole.
6. Disconnect the loop wire from the spring wire.

Tip: When you attach the loop wires to the spring wire, tie a 30-lb-test nylon fish line to the eyelet also. (I use one that is rolled into a carpenter's chalk line box.) This way when the loop is pulled through, you can "reel" the spring wire back down through the hole, then move on to the next window. This tool makes it possible for one person to run wire to the attic. Another trick is to have a whole bunch of spring fish wires about 3 feet long ready (for the do-it-yourselfer). After you drill each hole up into the attic, insert each fish wire into the holes with the lead wires attached to the bottom eyelet (make sure the fish wires will not fall out). Then go up to the attic and pull up all the wires at once (Fig. 17-34).

Figure 17-35 shows Labor $aving Devices' Extenzit telescoping retriever. This lightweight, shockproof, fiberglass pole is only 28 inches long when compressed into itself, but extends out to 8 feet! It's perfect to use with the Fish-eze tool. Other types of telescoping tools are available from this company, as well as other types of tools that can be applied to the installation and troubleshooting of alarm systems. For a full-line catalog and soon to be released video installation tapes, contact Labor $aving Devices at 1-800-648-4714.

17-35 A tool made for reaching across attic insulation. Labor $aving Devices

Additional tools

Here's a list of other tools and supplies you should not be without:

- Test meter: analog or digital multitester.
- soldering iron:100 to 140 watt
- staple gun
- jumper cables
- centering tools for lining up recessed magnets
- solder rolls: rosin core
- splice connectors: squeeze-type
- shrink (heat) wrap
- staple gun
- staples
- electrical tape
- number labels
- cable ties
- wire clamps
- grounding clamps
- terminal strips
- crazy glue
- RTV-type mounting compound
- varnish (for foil)
- wall anchors

- wire: 14 to 16 gauge;18 to 22 gauge twisted-pair
- foil repair tools

Test meters

The most versatile tool in any alarm installer's toolbox is the test meter. There are two types of test meters most often used: the analog meter (VOM), and the digital meter. Both types are also called multimeters or multitesters because they are designed to perform the functions of three separate meters. Either the analog meter or the digital meter can be used to measure voltage, current, and resistance in an electrical circuit.

Both types of meters are battery powered. They are designed for a variety of sensitivity ranges, usually from 1,000 ohms/volt or 20,000 ohms/volt. The 20,000 ohms/volt meter is more accurate, but also costs more. The 1,000 ohms/volt meter is not as accurate and only costs about half as much.

Digital multimeters have become increasingly popular due to their accuracy and ease of use. A digital multimeter in the 20,000 ohms/volt range will give you a very accurate reading, even if the test leads are placed in reversed polarity. There are no scales to read, only a digital display. They are more expensive than analog meters, but are well worth the price.

Both meters will give you average measuring ranges of:

ac volts to 1,000 volts
dc volts to 1,000 volts
dc current to 200 mA
ohms to 100,000 ohms

Although measurements as high as these will probably never have to be taken in alarm work (we hope!), it is a good guide to use when selecting a test meter.

Learning how to use your test meter should begin with a thorough review of the operating instructions supplied with the meter. Different manufacturers make different operating units. For simplicity sake, we will show you how to use a basic meter.

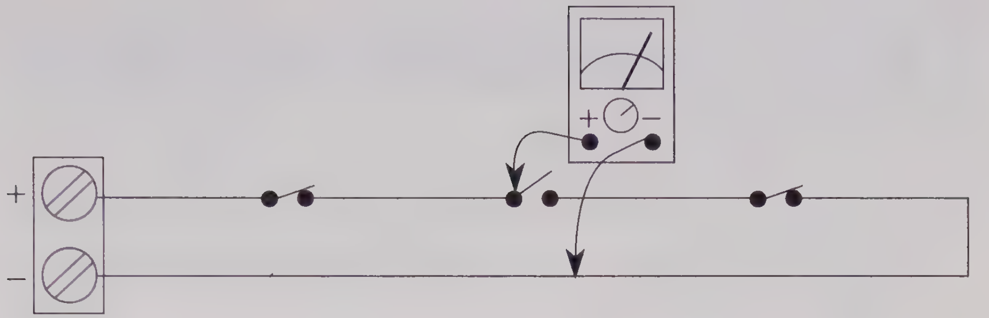
Caution!

1. Before taking any type reading, always zero the meter. Place the **black lead** into the **–negative**, and the **red lead** into the **+positive** jack, or the one marked /k (ohms). Touch the ends of the two leads together. Check the reading on the meter's **top red scale (OHMS)**, and be sure the needle is pointing to **zero**. If it is not, use the adjustment switch to correct it.
2. Set the **function/range** selector knob to the appropriate setting. If you do not know the range in which you should be working, set the meter to the highest range and then work your way down.
3. Always observe correct polarity, where necessary.
4. Double-check to be sure the test leads are in the proper jacks.

Measuring dc voltage

When measuring dc voltage place the meter's leads *across* the two points of the circuit being measured, as shown in Fig. 17-36. Remember that the unit must be on. Then:

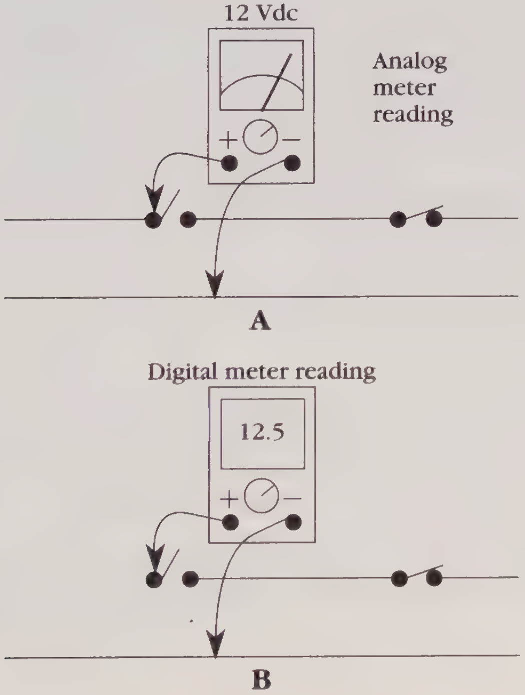
1. Set the Function/Range selector knob. (For alarm work 15 V.)
2. Place the negative lead (black) on the negative side of the circuit.



17-36 Shows how to measure voltage.

3. Place the positive lead (red) on the positive side of the circuit. The leads must be touching bare wire, switch terminals etc.
4. Read the meter on the bottom 15-V scale, for alarm work.
5. If the meter's needle deflects to the left, reverse the leads on the circuit. This means the polarity is incorrect.

You can test for polarity on a circuit when it is not known, by placing the negative lead of the meter on one wire, then quickly tapping the red lead of the meter on the other wire. See in which direction the needle deflects and adjust accordingly (Fig. 17-37).

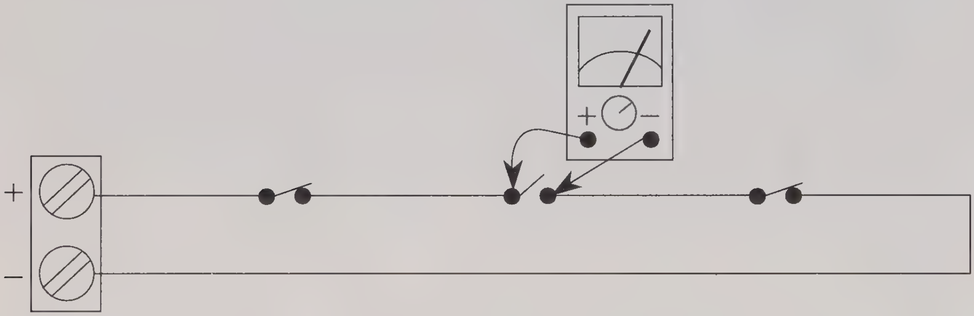


17-37
Two different types of meters give two different types of readings.

Measuring dc current

The power must be off when you measure dc current and you should **never** place the meter's leads across the circuit being measured. Place the leads in series with the circuit, as shown in Fig. 17-38.

1. Set the Function/Range selector knob. (DCmA)
2. Open the circuit to be tested. (Open the switch, device, etc.)
3. Place the negative lead on the negative side of the circuit. (This is the return side of the loop.)
4. Place the positive lead to the positive side of the circuit. (This is the side coming out from the control.)
5. Apply power to the circuit.
6. Read the meter. If the meter deflects to the left, reverse the leads on the circuit. (Polarity is reversed.)
7. Check the reading on the appropriate scale: DCmA. (The meter itself is completing the circuit.)



17-38 Shows how to measure direct current (dc).

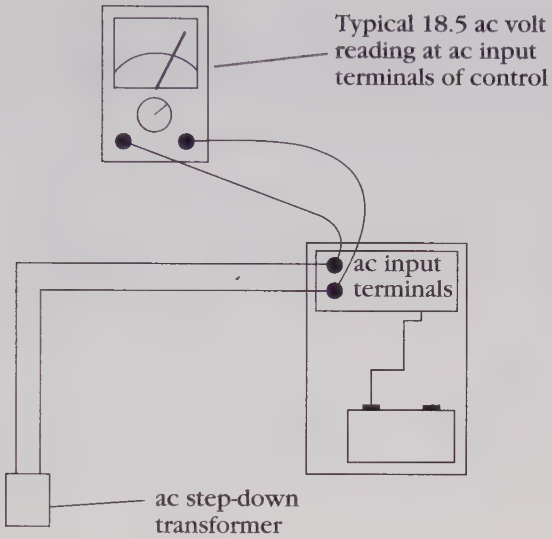
Measuring ac voltage

The power must be on when you measure ac voltage. Place the leads across the ends of the circuit being measured, as shown in Fig. 17-39.

1. Set the Function/Range selector knob (ACV).
2. Place one lead on one end of the circuit (polarity either way).
3. Place the other lead on the other end of the circuit.
4. Read the meter using the appropriate scale.

Probably the only place you will ever take an ac voltage reading on a control is at the ac input terminals. You can simply place your meter's leads on these two terminals and check the reading. For a reference, check the installation specifications for the appropriate range. If you have a control that is experiencing a power drop out, this is the first place you should check. Also check at the transformer's terminals to be sure the proper secondary voltage is being supplied.

Most meters will not measure ac current. You will also never have to measure ac current in an alarm system. For this reason only, I will not show you how to take an ac current reading. Figure 17-39 shows how to take an ac voltage reading. Polarity is unimportant.

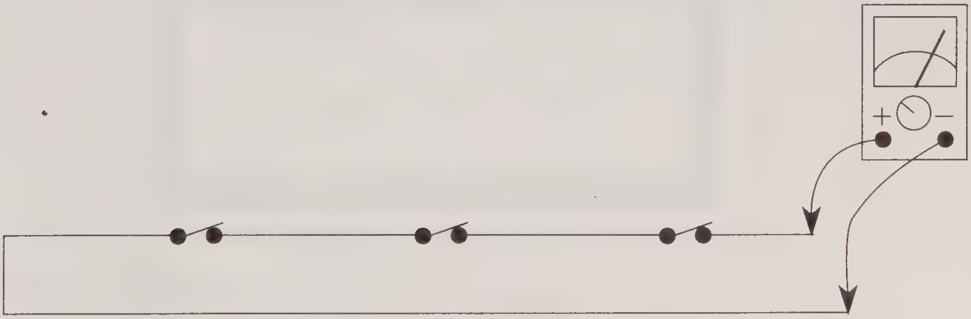

Typical 18.5 ac volt reading at ac input terminals of control
ac input terminals
ac step-down transformer

17-39 Shows how to measure the ac voltage output of the control.

Measuring resistance: ohms

The circuit being measured must be **disconnected** from the power source. When measuring resistance always place the meter's leads across the two ends of the circuit being measured, as shown in Fig. 17-40. Polarity is unimportant.

1. Set the Function/Range selector knob (ohms).
2. Remove the circuit being tested from the power source.
3. Place one lead on one end of the circuit.
4. Place the other lead on the other end of the circuit.
5. Read the meter on the top (red) ohms scale.
6. The needle will deflect to the right. If it does it is showing a resistance reading. (The circuit is closed.)
7. If the needle does not move (shows Infinity), the circuit is open.



17-40 Shows how to measure resistance. Notice the loop has been removed from the power source.

INSTALLING PROTECTIVE DEVICES

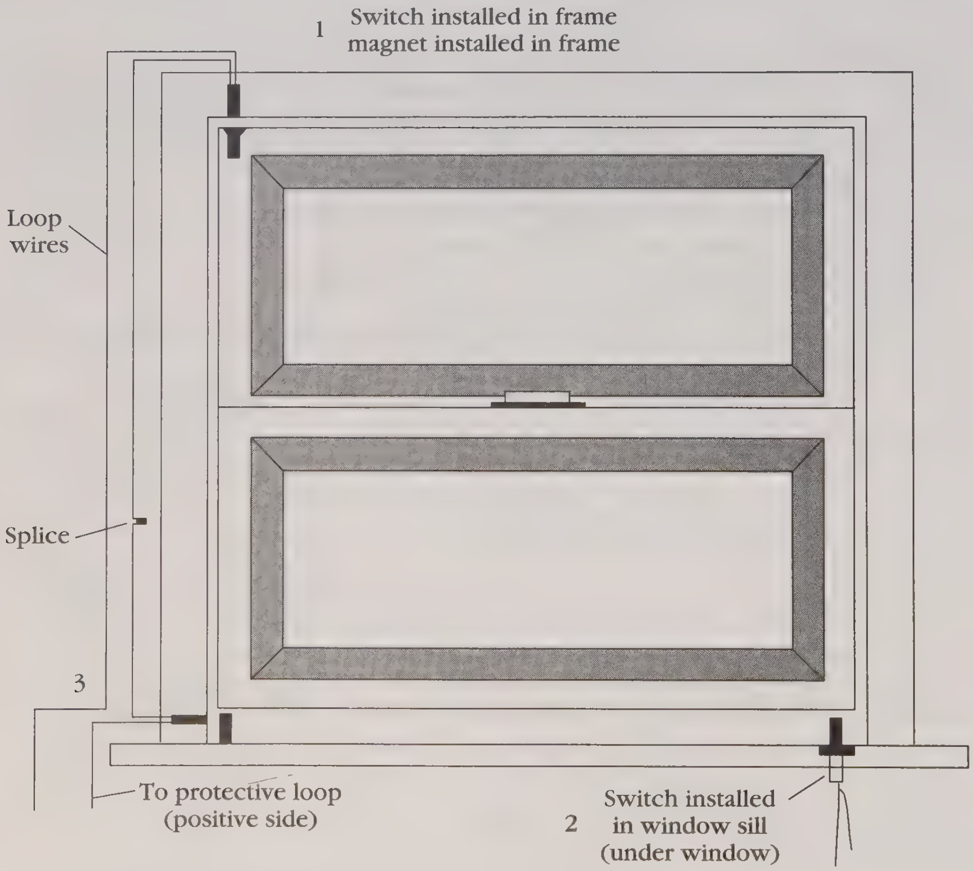
Let's look at the installation procedures for a variety of protective devices.

Magnetic contacts

There is a large variety of magnetic contacts that can be installed. Because space is limited I will show you examples of how to install the most common magnetic contacts. Every installation will have its own unique situation (such as differently designed windows, doors, framing methods used, etc.), therefore you should use these examples as a basic reference only.

Protecting windows (double-hung)

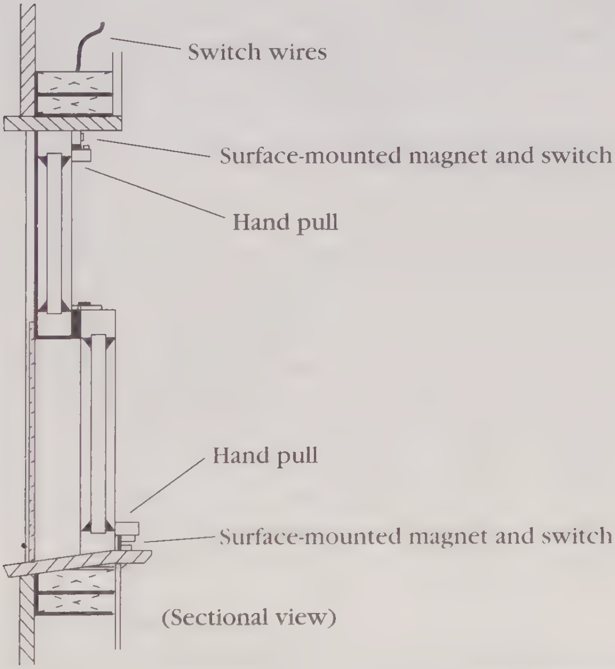
Residential windows are usually protected by concealed (recessed) contacts. Figure 17-41 shows three different installation methods. In each method, the switch portion of the contact is installed by drilling the proper size hole (according to manufac-



17-41 Magnetic contacts can be installed in a window in a number of ways. Notice how two contacts are connected in series to protect the top and bottom window.

turer) into the window jamb (header, sill, side jamb). The switches are gently pushed into the hole and friction-fitted or glued into place. These switches usually come with leads attached that protect the protective loop (attach to the positive side of the loop for series circuits). Splice one wire of one switch and one other wire of the other switch. Splice the remaining two wires to the positive side of the protective loop. Usually you can remove the window casings to make splices and hide the wiring.

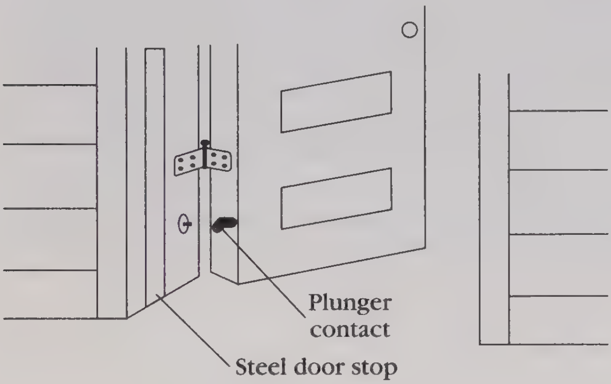
Although concealed contacts are preferred for residential work, you can also install surface-mounted contacts. This type is not hidden. If you decide to install this type, use the miniature versions. If installed neatly and with a color that blends with the window, they are hardly noticeable. Figure 17-42 shows surface-mounted contacts installed on a European-type replacement window. Notice how these are totally impossible to reach (or sometimes even be seen) from the outside of the building. Either type contact (concealed or surface-mounted) is wired up the same. Notice how the magnet is mounted on the top of the hand pull. This allows it to be completely hidden from view from the outside. This method can be used on many of the replacement windows that are manufactured today.


Switch wires
Surface-mounted magnet and switch
Hand pull
Hand pull
Surface-mounted magnet and switch
(Sectional view)

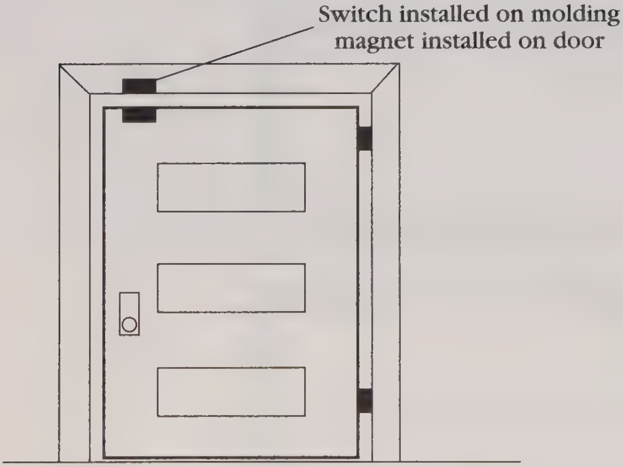
17-42
Magnetic contact installation in a European-type replacement window.

Protecting doors

Doors can also be protected with concealed contacts or surface-mounted contacts. A concealed contact can be placed on the hinge side of the door, or on the latch side. Roller-ball or plunger-type switches are favored by installers because there is no magnet to align. These type switches should be installed at the hinge side of the frame. Doors with aluminum thresholds can have the switch portion of a concealed contact installed underneath the threshold. The magnet then gets installed at the bottom edge of the door. It should be noted that when installing contacts for doors, there should be a burglar-resistant barrier installed on the outside of the door (guardplate) where the contact is to prevent the contact from being defeated from the outside. This is extremely important for outswinging doors. Outswinging doors should be protected with inside surface-mounted contacts (Figs. 17-43 and 17-44).

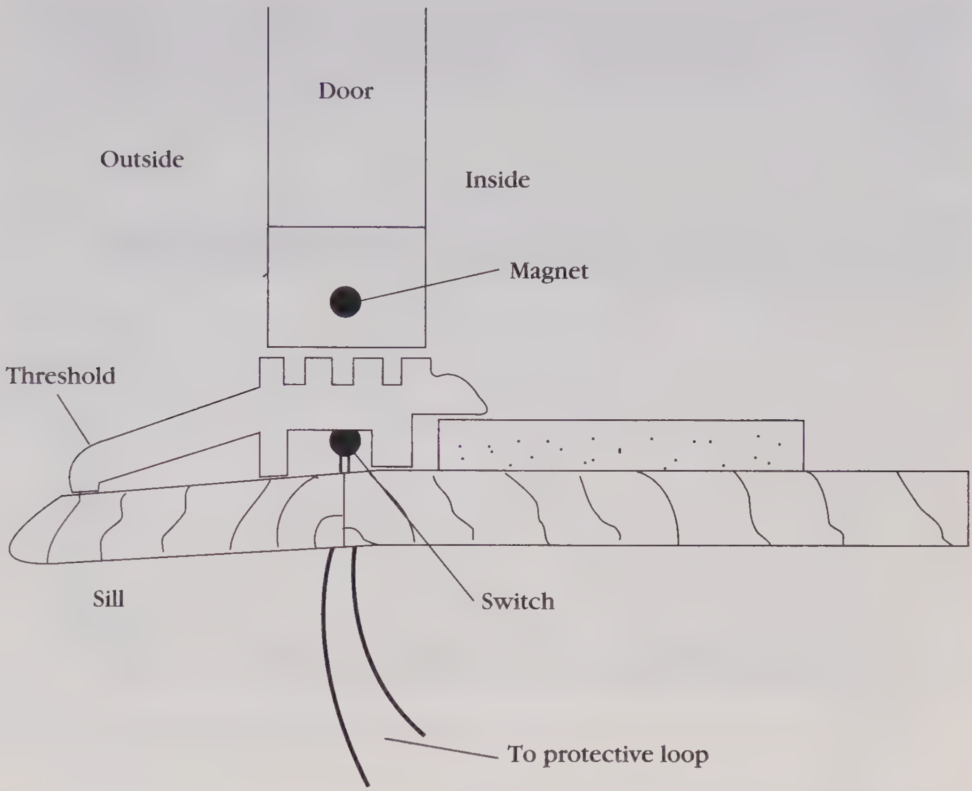


17-43
Plunger contacts are commonly used to protect doors.



17-44
A surface-mount contact installed on the inside of a door frame.

Figure 17-45 shows how a contact can be installed underneath an aluminum threshold. Because of the distance between the switch and the magnet a wide-gap contact must be used. Mount the switch portion to the underside of the threshold with an RTV-mounting compound. Align the switch so it is centered with the magnet that is installed in the bottom of the door. (Follow the manufacturer's instructions for lining switches up properly. Some ends are colored-coded for proper alignment.) Test the switch by connecting the wire leads to an ohmmeter and opening and closing the door.



17-45 Installing special under-threshold contacts gives the ultimate in aesthetic appearance as well as supplying a high level of anti-tamper protection.

1. At the bottom of the door, drill a hole on the center edge leaving about ⅜ inch from the bottom of the contact to the bottom of the door.
2. Make a mark on the jamb where the door sits flush on the inside.
3. Measure from that mark the thickness of the door.
4. Make a mark on center, then transfer to the threshold.
5. Remove the threshold and glue the switch in the appropriate spot.
6. Drill a hole to route the switch's leads to the protective loop (Fig. 17-45).

INSTALLING FOIL

Installing foil can be a frustrating experience for the first-time installer. Foil is extremely thin and delicate and if not handled properly can be damaged. Foil is installed in a straight line about 3 to 4 inches away from the edge of the glass on large panes, and about 1½ to 2 inches away on smaller pane glass.

The oldest method of applying foil was to brush or roll on a thin undercoating of varnish over the area where the foil would be applied. The foil was then pressed onto the glass on top of the varnish. When the varnish was dried and the foil secure, a top-coating of varnish was applied on top of the foil to protect it and seal it to the glass. When the glass was broken the varnish would crack, move and break the foil tape, break the protective circuit, and initiate an alarm.

Although foil today still works the same way, now it can be applied without the undercoating of varnish. Self-adhesive foil tape has an adhesive backing that causes it to stick to the glass when you press it into place. It still requires, however, the top coating of varnish to protect it and seal it to the glass.

There are a few foiling application tools you can purchase to make this awkward job easier. However, in time, and quite quickly, you can be foiling windows with expert precision and hawk-eyed vision. Here are a few basic rules and steps for foiling with self-adhesive foil:

1. The glass must be completely **dry** and **clean**.
2. Use tailors chalk or any other type marking pencil, which can easily be removed, to mark a straight guide line to follow with the tape. The line can be put on the outside of the glass, or on the inside. Use a wooden block or anything else that will butt up against the inside edge of the window frame to guide the line.
3. Install the take-off blocks where the foil will start and return. These are self-adhesive and simply stick on the glass. Install them from where the protective loop wires will feed.
4. Hang the roll of foil tape above you on the molding with a nail, or use a suction device to hang a foil holder and dispenser on the glass. Hanging the foil above you will make it easier to work with and avoid a lot of tangles and snags. Some distributors sell a special pulley-type foil holder for this purpose.
5. Starting at the feed side of the take-off block, leave about a 1-inch lead of foil passing over and past the block. This piece will be used later to attach underneath the block's holding plates.
6. Apply the foil to the glass about 1 foot at a time, keeping the foil aligned with the guide line. Do not cut the foil at any time (unless absolutely necessary). Apply the foil in one continuous length.
7. Use a slight stretching movement to prevent any slack. Press the foil down firmly, and push or roll out any bubbles or folds in the foil. (You can use a matchbook cover for this, or even a wallpaper seam-rolling wheel.) If you use the matchbook cover, please do not use the side with the staple in it!

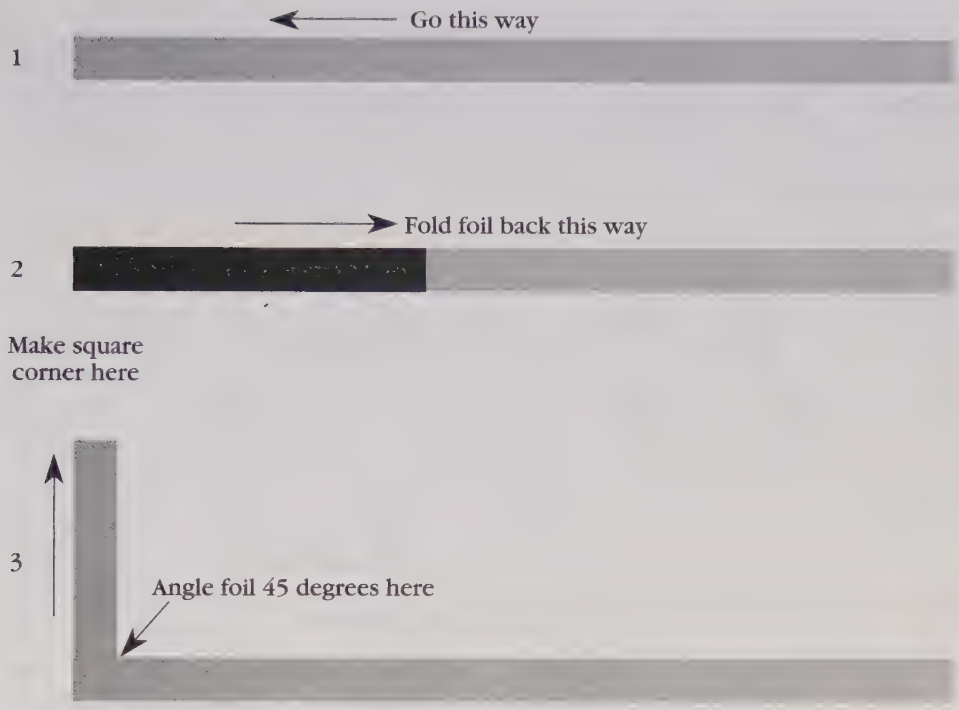
Turning the corner

This is the fun part! It is also the mark of a true foiling master. It is also the hardest step for the novice. Be patient! You shall overcome!

To turn the corner, you have to first **fold the foil in the opposite direction you were just going! This is called a double fold**, and is shown in Fig. 17-46.

Once you've foiled your way back to the take-off block, leave enough slack to be able to fold the foil under the block-clamping plate the same way you did when you started. Follow these steps to connect the foil to the take-off blocks:

1. Remove the clamping-plate screw and the plate.
2. With a matchbook "flush" the foil squarely up against the bottom edge of the ramp (where the foil rides up the block plate).
3. Press the foil down onto and up the ramp, covering the screw hole.



17-46 The proper procedure for installing window foil.

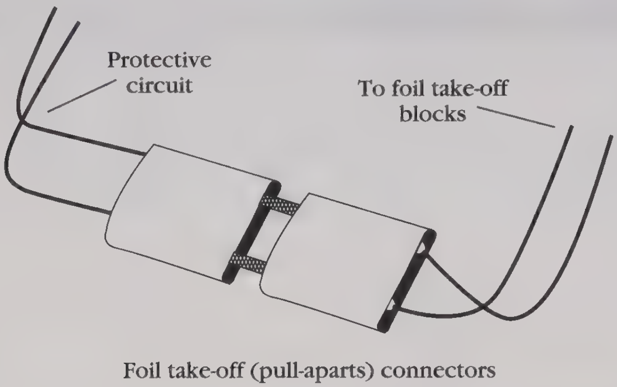
4. Fold the foil back down the ramp (but not past the edge of the holding plate). Making one or two extra folds under the clamping plate will make the connection more secure and prevent the foil from ripping where it leaves the take-off block. Pinch a hole in the foil where it lays over the screw hole.
5. Replace the plate and screw.
6. Connect the protective loop wires underneath the clamping-plate screws.
7. Apply a top-coat of varnish on the foil. The varnish should not extend more than 1/16 to 1/8 inch past the edges of the foil. Use a small brush or roller that is the same size or slightly wider than the foil.

Tips and tricks

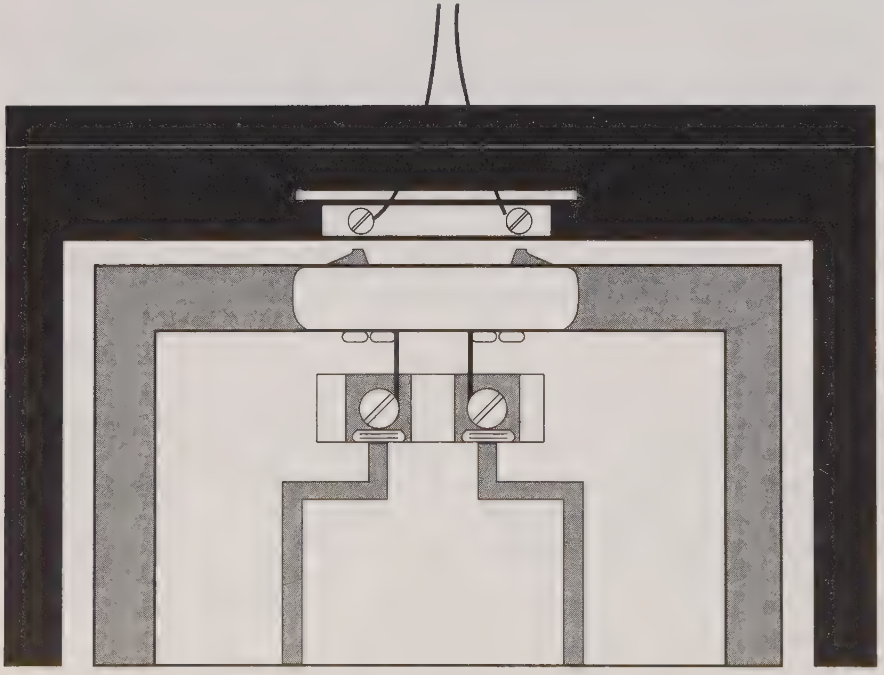
Foiling on a cold winter day can cause moisture problems on glass that will have you pulling your hair out if you use self-adhesive foil tape. Condensation will not allow the tape to stick, and the cold air can quickly deactivate the adhesive backing. These steps will help you finish the job.

1. Make sure the glass is completely clean and dry. You can use a hairblower to keep the glass dry while you apply the tape.
2. Place the roll of foil on a radiator or any warm surface to prevent the adhesive from drying up.
3. Wear surgical or thin cotton type gloves. Oils and moisture that come off your fingertips can prevent the foil from sticking.

There are a variety of foil connectors that can be used to attach the foil to the protective circuit. Basically, the difference lies in whether or not the window is moveable. Nonmoving windows pose no problems, so the standard take-off block can be used. For windows that must be opened, you can use either a foil take-off (pull-apart) connector, like the one shown in Fig. 17-47, or a window-foil take-off contact, as shown in Fig. 17-48.



17-47 Pull-apart connectors are perfect for allowing windows protected with foil to be opened easily.



17-48 Window foil takeoff-contacts eliminate hanging wires from pull-apart connectors and are user-convenient.

The take-off connector allows the window to be opened a certain amount before the connection between the foil and the protective circuit is broken. This type of connector can be used where it is difficult to make a connection from the foil take-off block to the protective circuit. It also can be used if it is desired that the take-off connector be used as a window contact also. In this instance, the connectors would pull apart once the window was opened. They must be reconnected though when the window is closed. The amount of slack used is important if they are used for that purpose.

A foil take-off contact can be used for the same purpose. This type is preferred since there are no loose hanging parts like in the above example. There are also two parts to this contact. The spring portion of the contact is mounted on the top rail of the moveable window. Wires connect this part to the foil take-off blocks that are on the glass. The protective circuit connects to the part on the window frame. The spring clips make or break the connection when the window is moved up or down.

For windows that have multi-panes, foil crossovers can be used. Crossovers are conductive strips of bridging that are insulated on the bottom side where they are glued or stuck onto wooden or metal grills that hold the window panes together. They are either soldered to the foil or have an adhesive backing. **Never cross Foil over any conductive surfaces. Never cross Foil over itself or a short will occur.**

INSTALLING PIRs

Before you install a PIR, be sure that objects in the area will not interfere with the proper operation of the unit. You should also make sure that the coverage pattern you're assigning to the unit will protect as large an amount of the area as possible. Here are a few installation hints:

1. Do not install the detector where it will be exposed to direct sunlight, or directly above strong sources of heat.
2. Make sure that there are no large objects within range that can block the protection pattern.
3. Do not locate the unit where its protection patterns will be exposed to rapid rises in temperature like: radiators, boilers, fireplaces, stoves, blown hot-air ducts, etc.
4. Mount the unit about 7 feet from the floor, or according to any special installation requirements.

Note: Remember that PIRs sense a sudden and slight temperature rise in the protection area. This capability can best be enhanced by causing an intruder to step across the protection pattern rather then straight into it.

Power requirements

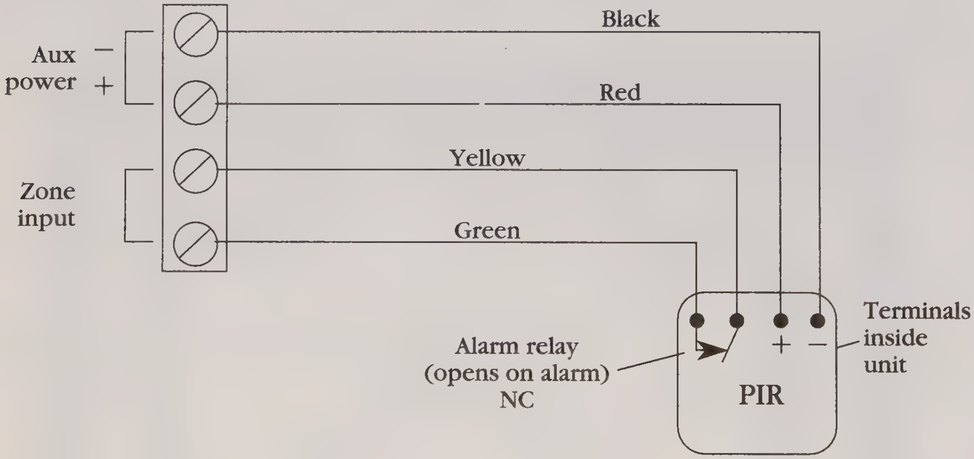
Most PIRs draw their power directly from the auxiliary power output of the control. There are some units that use batteries that are installed directly into the unit; however, since these units rely on battery power to operate, they do pose an obvious disadvantage. Another way of supplying power to a PIR is through the use of a separate power supply and transformer. The transformer steps down the initial ac voltage, while the power supply converts this voltage to dc and supplies the proper current to operate the unit. This last method is not commonly used, but is a good last resort if a unit is to be added on at a later date, and where a detection circuit is nearby to which the PIR can be wired. This alleviates the necessity of running a new power line, or picking up from one that may be far off or difficult to reach. When installing PIRs always check the manufacturer's power current and voltage requirements before operating the units.

Wiring

You will need a 4-conductor cable (quad) to wire PIRs to the control. Two wires of the 4-conductor cable will supply the detection circuit (protective loop), while the other two wires will supply the power from the control. It is a good habit to get using color-coded wires for identification purposes. The common quad cable sold at most alarm suppliers will be color-coded black and red, and green and yellow. Use black and red for the power lines: black for the negative, red for the positive, and the green and yellow for the detection circuit. (Make sure the way you wire the unit matches the way the wires are connected at the control.)

There are basically two different ways you can configure the hookup of PIRs. Depending on what your zoning requirements are you can run a couple of PIRs in series, whereby they would be connected to the same loop and act as one zone. In this arrangement, bypassing the loop at the Keypad would shunt out all the PIRs on that loop. The other method is to wire them individually, or "home-run" each individual unit back to the control, to allow for individual shunting.

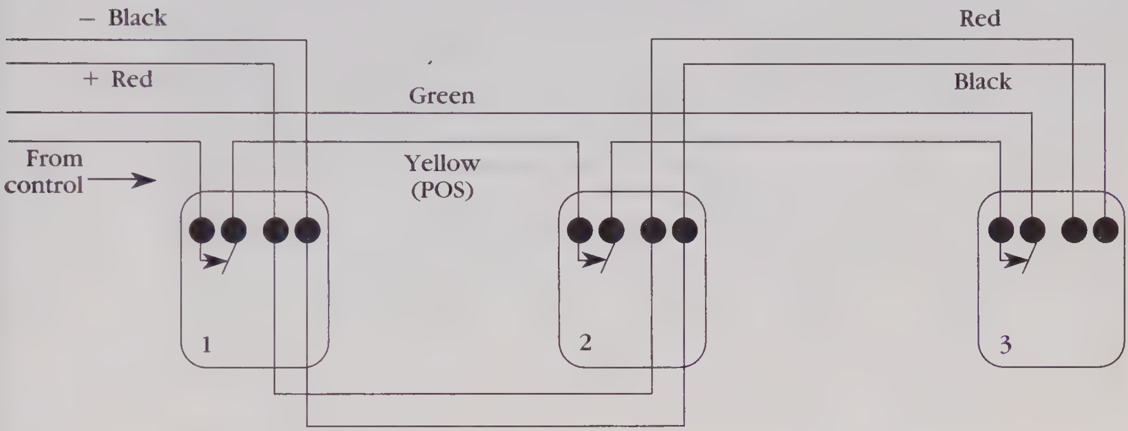
Figure 17-49 shows how one PIR would be "home-runed" to the control. The detection circuit is ended at the NC alarm relay inside the PIR. When the unit senses a quick change in temperature, the relay will open and initiate an alarm.



17-49 A PIR home-runed to the control.

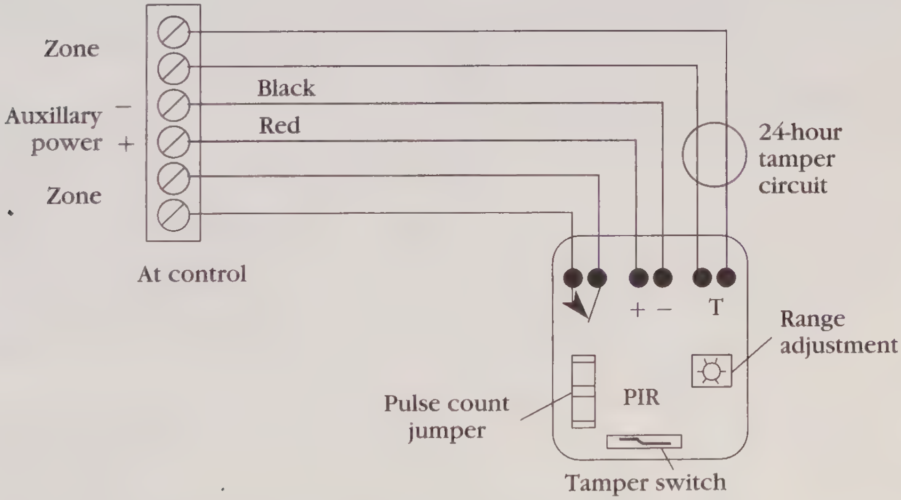
If you're using EOLR circuits, place the resistor inside the unit. (Use the same method as for contacts.) Usually, 22-gauge, 4-conductor cable is used, however follow basic wire resistance rules to determine the proper gauge to use for very long wire runs.

Figure 17-50 shows how to run PIRs in series. Notice how only the **positive** side of the detection circuit gets connected to the relay's terminals. This is to be done for units that use only NC relays (some units will give you a choice of NC or NO). The detection circuit ends at the last detector. The power lines are fed in and out of the power terminals. It is extremely important to observe proper polarity. Keep positive with positive, and negative with negative, and wired to the proper terminals.



17-50 How to hook up more then one PIR in a single loop.

Some units will offer the addition of a built-in tamper switch. This is to provide annunciation in case the unit's cover is removed without authorization. The extra two wires that connect to the tamper switch should be connected to a 24-hour zone at the control, as shown in Fig. 17-51.



17-51 Some PIRs have tamper circuits that can be hooked up to the control.

Depending on which manufacturer's unit you are using, some adjustments might have to be made to range control, pulse count settings, height or lateral beams, pet alley options. Masking might also be required. Read the manufacturer's instructions carefully and be sure to walk-test each unit before final settings are made.

INSTALLING AND MOUNTING SMOKE DETECTORS

Before you install smoke detectors you should be aware of the proper procedures and standards concerning the installation of household fire warning equipment. Fire is a serious catastrophe that can quickly cause the loss of human life, therefore the minimum standards, as set forth by the National Fire Protection Association (NFPA) should be studied and closely followed when you install residential systems. (Commercial fire alarm systems are much more technically involved, therefore I will not discuss them. You can contact the NFPA at 1-800-344-3555 for more information.) I recommend that you contact the NFPA and ask for a copy of Code NFPA74, which covers the selection, installation, and maintenance of household fire warning equipment.

This section will discuss the general procedures for installing electrically powered and monitored smoke detectors. It will also discuss heat detectors, in combination burglary/fire alarm systems for residential use. Because of the seriousness of fire I have expanded this section to discuss many aspects concerning the use of fire warning equipment in residential use, so beginners can supply adequate fire protection for their own systems and for those of their future customers. Here are the answers to some questions:

Where should fire detectors be located?

Minimum standards require that fire detectors be located outside of, but in the immediate vicinity of, each separate sleeping area; on each floor, and in the basement, attic, and crawl spaces.

Although the NFPA74 code sets these locations as the minimum standard, they also suggest that additional smoke or heat detectors be placed inside each area that is separated by a door, from those areas that already contain smoke or heat detectors. However the addition of extra detectors remains the option of homeowners.

What kind of sounding device is required?

According to the standard, the same sounding device that is used for the burglary portion of the system can be used, as long as it provides for a separate and distinguishable "pulsing" sound for fire alarms. It should have a minimum rating of 85 dBA at 10 feet. It should also be able to be heard over appliances in bedrooms, like air-conditioners, humidifiers, etc., which might be on during the sleeping evening hours. The greatest threat to a family from fire is usually during sleeping hours when awareness is low, and reaction to an emergency is slow. Therefore the earliest warning from detectors that set up a "boundary" between the fire and persons sleeping will offer the most protection, and probably will save lives.

A good location for smoke detectors is at the top of stairwells. Smoke will automatically rise to the highest level of a room and fan out across the ceiling. However, smoke detectors that are installed in stairwells should not have a closed door at the bottom of the stairwell, for this would block the flow of smoke to the detector. In such a situation it would be better to install the detector at the bottom floor in close proximity to the stairwell door.

What type of power supply is required?

In common residential/combination systems, the control device that fire detectors are connected to should be able to operate the fire signaling equipment (siren, bell, speaker) for at least four continuous minutes. This applies to the primary power and back-up power (battery). However, the panel should be able to warn (annunciate) of any trouble on the fire detection and power circuits, and also if the back-up portion of the system is incapable of supplying sufficient power to the system. Most system-connected smoke detectors operate on 12 volts and draw small amounts of current. Manufacturers' instructions should be followed closely when determining power requirements.

Trouble, like a loss of power, or an open in the fire detection wiring to smoke detectors should not initiate an alarm condition, but should annunciate at the panel or keypad that such a condition exists.

Where on a ceiling should smoke detectors be mounted?

Rule number one is **never** mount smoke detectors in the corner of a ceiling. The space where the ceiling and walls meet naturally creates a "Dead" air space that smoke has difficulty reaching. This dead air space is typically 4 inches across the ceiling from the corner, and 4 inches down the wall from the corner. Do not place smoke detectors in this dead air space or they will be rendered ineffective. If you have no alternative but to mount a detector on a side wall, then mount it between 4 and 12 inches from the ceiling (preferably as close to the ceiling as possible).

Smoke detectors should be mounted towards the center of the ceiling, or where the location of the detector evenly diminishes the distance from each wall so only one is sufficient.

What are the spacing requirements?

A spacing of anywhere from 30 to 50 feet across unobstructed air space (like that of a smooth flowing ceiling) is usually considered standard between smoke detectors, but check the manufacturer's instructions as the standard varies by product. Ceilings that have exposed joists should have the detectors mounted on the bottom of the joists. The reason for this is that even though smoke can flow freely down the upper floor channels of floor joists, it cannot flow as freely across the joists. The joist channels act as "smoke traps" and therefore smoke detectors should be placed at closer intervals (when figuring mounting locations across the joists). The same principle applies to the spacing of heat detectors.

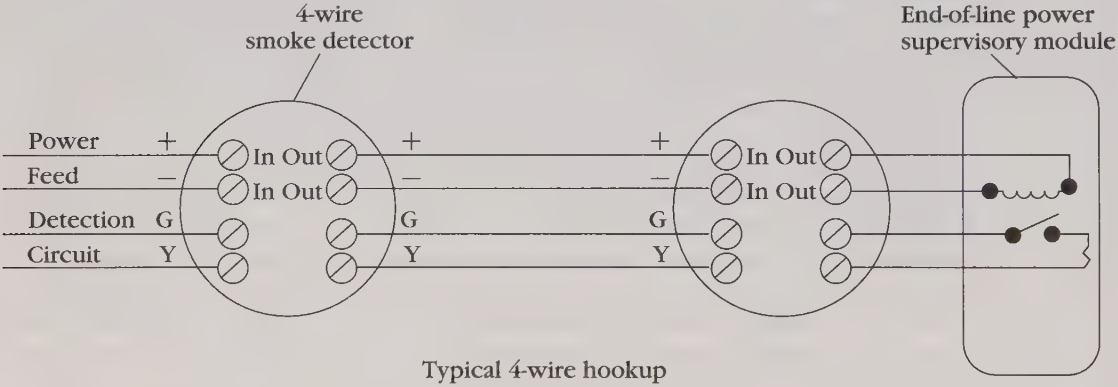
How many detectors should be used?

The minimum standards should be followed, however better protection obviously will be afforded if either type of detector, smoke or heat, is installed in each separate living and sleeping area. Each installation is individualistic, therefore the proper types and amount of detectors to be used should be determined by the installer or dealer.

WIRING SMOKE DETECTORS

Smoke detectors are NO devices. Like PIRs they can be run in groups or run separately (home-runed) back to the control. Some smoke detectors use a 2-wire connection, which acts as the detection circuit and supplies the power to operate the unit (these draw less power). Others use a 4-wire connection, where one pair supplies the power and the other pair the detection circuit. It is important to know which type of detector (2-wire or 4-wire) the control you are using can support. Not every control panel is compatible with 2-wire smoke detectors. Check with the supplier who is selling you the equipment. The main difference in wiring up smoke detectors is to remember that they are NO devices. Therefore, where more than one will be connected together (in the case of 4-wire and 2-wire detectors) they should be connected in parallel. Some smoke detectors have "in" and "out" terminals, some do not.

Figure 17-52 shows how 4-wire smoke detectors are wired up. These detectors have in and out terminals. When using detectors that do not, use care to ensure that the wires are not crossed. This figure also shows an end-of-line power supervisory module placed at the end of the circuits after the last detector. The purpose of this type module is to supervise the power line. Should the power go down on this line, the coil of the relay will de-energize and cause the switch to open, which breaks the supervised loop. This condition will be annunciated as a "trouble" signal at the system's keypad or control. Notice the EOLR that is built into the module. This resistor should match the resistance value of the loop. Different types of modules are intended for certain controls, so be sure to check with the supplier of the equipment for the correct one. (2-wire smoke detectors are wired in the same manner.)



17-52 How to hook up smoke detectors.

INSTALLING HEAT DETECTORS

For areas where smoke detectors are not desirable, such as attics, kitchens, and garages, heat detectors should be used. A heat detector is a device that detects abnormally high temperatures or a sudden and quick rise in temperature. Heat detectors should be used in areas where environmental conditions are unstable, like dusty areas (attic), workrooms or garages where a lot of airborne dirt might be a problem, or in kitchens where cooking smoke might cause false alarms, or other living areas where cigarette smoke is normally present. The standards for mounting heat detectors are basically the same for those of smoke detectors. Fixed-temperature and rate-of-rise heat detectors should be chosen carefully. Some areas of a home, such as attics and boiler rooms, might have temperatures normally much higher than other areas. For these areas it might be best to install detectors with a higher fixed thermostat (190 degrees).

Also be careful where you install heat detectors. Do not install them directly above radiators, boilers, stoves, refrigerators, or any other object that normally produces a rapid heat rise. For more on the installation, operation, and maintenance of fire protection devices, the following reports should be thoroughly read and understood:

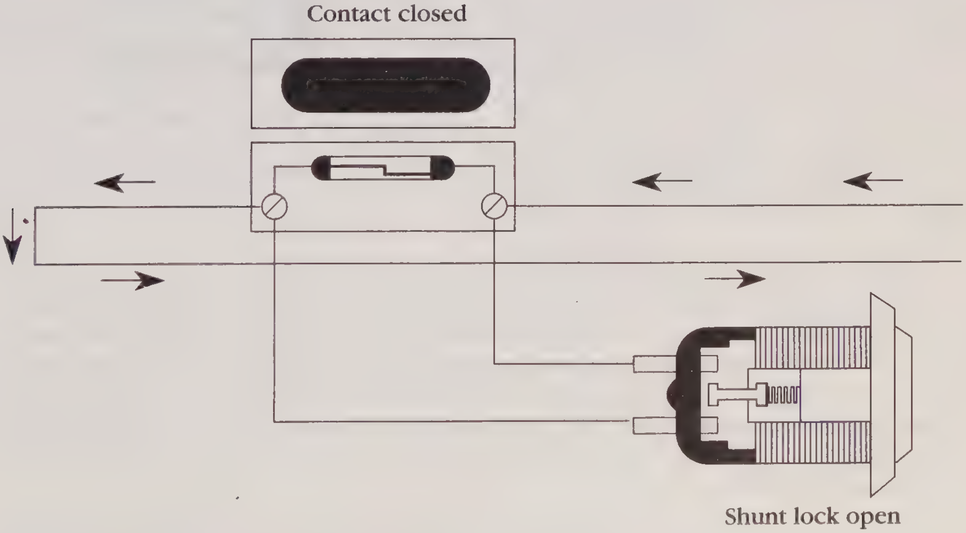
- *NFPA 74 Household Fire Warning Equipment 1989 Edition*
- *NFPA 72E Automatic Fire Detectors*
- *National Electrical Code 1990, Article 760*

The second most important thing you can do to protect yourself and your family from the threat of fire, is to have a well-rehearsed escape plan. Exiting from a bedroom window should be planned. The opening of any doors should be prohibited in a fire to prevent the spread of fire and smoke and avoid injury. Speed is essential when escaping from a fire. Drills should be conducted periodically, and all family members should have their own individual escape routes from their part of the premises. Fire extinguishers should be placed strategically to aid in your escape. Child and infant reflective stickers should be placed on children's windows to help fire-fighters locate these rooms first. Careful fire escape planning should not be viewed as a nuisance, but rather as a necessity. After all, your very life might depend on it one day. For more on proper planning of fire drills and escape routes, contact your local fire department for more information.

INSTALLING A SHUNT SWITCH

A shunt switch (or lock) is a bypass switch. It is usually installed by an entrance door that enables the door to be opened while the system is armed, without causing an alarm. The shunt switch gives current an alternative path to flow. It bypasses the switch to which it is connected.

In Fig. 17-53, a series circuit switch is closed. An on/off key switch has been connected to the terminals of the contact. The switch has a spring-loaded roller contact

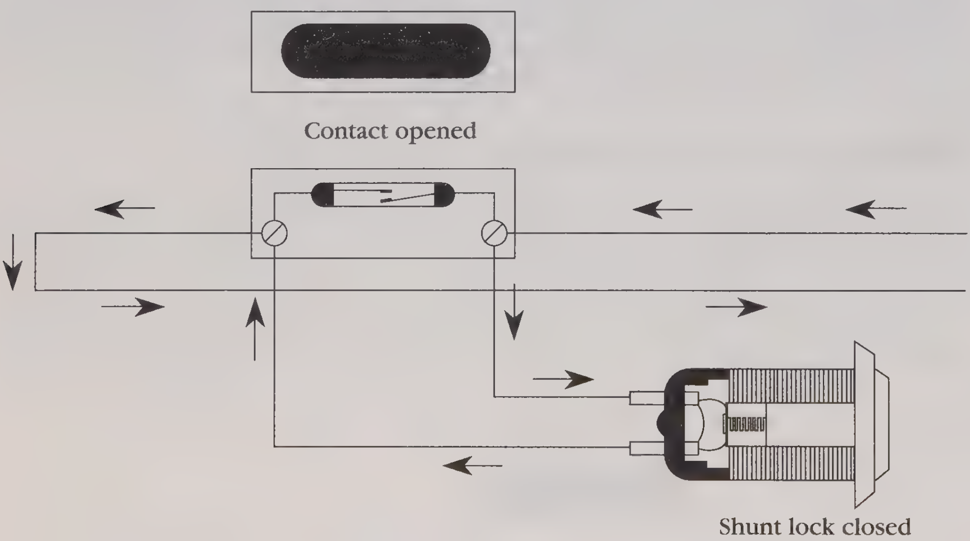


17-53 How to hook up a shunt lock switch in a series circuit.

that when opened does not make contact with the switch's terminals, which are connected to the loop contact. In this position, the shunt lock has no effect on the contact.

The arrows in Fig. 17-53 show the path of the current. Because the contact switch is closed, the current can take its normal path around the loop, bypassing the shunt switch. The current will not go through the shunt switch because the switch's contacts are open, cutting off the current.

In Fig. 17-54, the loop contact has been opened. Current now cannot go through the contact. The current must look for an alternative path back to the control. If you look at the shunt lock you will notice that it has been closed. The spring-loaded contact is making contact with the lock's rear terminals that are connected to the loop contact. This supplies the alternative path back to the control. The current goes to the first terminal of the contact switch, down into the shunt lock, then back to the other side of the contact switch, and finally back to the control. The opened loop contact has been successfully bypassed. There is one rule to remember: the shunt lock must be closed before the loop contact is opened or an alarm will occur.



17-54 The arrows show how current is diverted away from the shunted contact, preventing an alarm when the contact is opened.

There are many different types of shunt switches you can use. The type shown here is a simple on/off switch that latches into place. Some switches have "momentary" operation. These types stay in one position while held, then spring back when released. These types are good when answering the door to talk to a stranger. If released while the door is still open, an alarm will sound, which is a perfect hold-up or panic switch. Some come as key locks, others are simple push-button types. They are available in SPDT, or double-pole-double-throw (DPDT) which will perform more than one function at once.

Note: When installing a shunt lock in an EOLR circuit, be sure that the wires going to the shunt lock are installed on the switch's terminals. It is common to see the wires of the shunt connected in parallel to the loop before the contact to be shunted. This is okay as long as the resistor is placed before the shunt's wires or the resistor will be "shorted" out when the shunt switch is closed and cause an alarm.

When using shunt switches always be sure to place the shunt switch back in the opened position after use to avoid any unintentional bypassing of the circuit.

A

Locksmith schools

Academy of Locksmithing
2220 Midland Ave., Unit 106
Scarborough, ONT M1P 3E6
Canada
(416) 321-2220

Acme School Locksmithing Division
11350 S. Harlem
Worth, IL 60482
(708) 361-3750

Abram Friedman Occupational Center
1646 S. Olive St.
Los Angeles, CA 90015
(213) 742-7657

California Institute of Locksmithing
14721 Oxnard St.
Van Nuys, CA 91411
(818) 994-7425

Colorado Locksmith College
4991 W. 80th Ave.
Westminster, CO 80030
(303) 427-7373

Edu-Tech
954 Beaconsfield, P.O. Box 36791
Grosse Point, MI 48236
(313) 824-2710

Foley-Belsaw Institute
A Division of Foley-Belsaw Co.
6301 Equitable Rd.
Kansas City, MO 64120
(800) 821-3452

Golden Gate School of Locksmithing
3722 San Pablo Ave.
Oakland, CA 94608
(510) 654-2677

Granton Institute of Technology
263 Adelaide St.
W. Toronto, ONT M5H 1Y3
Canada
(416) 977-3929

HPC Learning Center
3999 N. 25th Ave.
Schiller Park, IL 60176
(708) 671-6280

Lock and Safe Institute of Technology, Inc.
1650 N. Federal Hwy.
Pompano Beach, FL 33062
(305) 785-0444
(800) 457-LOCK

Lockmasters Professional School
5085 Danville Road
Nicholasville, KY 40356
(606) 885-6041
(800) 654-0637

Locksmith Business Management School
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Emeryville, CA 94662
(510) 654-2677

Locksmithing Institute
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Fairfield, NJ 07004
(201) 575-5225

Locksmith School
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Toronto, ONT M3l 1A2
Canada
(416) 960-9999

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Indianapolis, IN 46217
(317) 632-3979

North Bennet St. School
39 N. Bennet St.
Boston, MA 02113
(617) 227-0155

NRI School of Locksmithing
4401 Connecticut Ave. N.W.
Washington, DC 20008
(202) 244-1600

Omni College
7636 Burnet Ave.
Van Nuys, CA 91407
(818) 787-OMNI

Pine Technical College
1000 Fourth St.
Pine City, MN 55063
(612) 629-6764
(800) 521-7463

Prince Georges Community College
301 Largo Rd.
Largo, MD 20772-2199
(301) 322-0871

Quintilian Institute
5001 A Lee Hwy, Ste. 101
Arlington, VA 22209-0351
(703) 525-7525

Sea Isle Vo-Tech
5250 Sea Isle Rd.
Memphis, TN 38117
(901) 684-2154

Security Education Plus
210 N. Main St.
P.O. Box 497
Nicholasville, KY 40340-0497
(606) 887-6027

Security Systems Management Schools
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Fairfield, NJ 07004

Southern Locksmith Training Institute
1387 Airline Dr.
Bossier City, LA 71112
(318) 227-9458

Stotts Correspondence College
Australian College of Locksmithing
140 Flinders St.
Melbourne, Vic., 3000
Australia

Sydney Institute of Technology, Ultimo
Locksmithing Section
Bldg. M, Mary Ann St.
Ultimo NSW 2007
Australia
(02) 217-4008

Universal School of Master Locksmithing
3201 Fulton Ave.
Sacramento, CA 95821
(916) 482-4216

Valley Technical Institute
5408 N. Blackstone
Fresno, CA 93710
(209) 436-3814

B

Domestic and international locksmith associations

NATIONAL ASSOCIATIONS

American Lock Collectors Association
36076 Grennada
Livonia, MI 48154
(313) 522-0920

American Society for Industrial Security
1655 N. Ft. Myer Dr., Suite 1200
Arlington, VA 22209
(703) 522-5800

Associated Locksmiths of America, Inc.
3003 Live Oak St.
Dallas, TX 75204
(214) 827-1701

Builders Hardware Manufacturers Association, Inc.
355 Lexington Ave., 17th Floor
New York, NY 10017
(212) 661-4261

Door and Hardware Institute
14170 Newbrook Dr.
Chantilly, VA 22021-0750
(703) 222-2010

Institutional Locksmiths Association
PO Box 4097
Dedham, MA 02026-0902

Lock Museum of America, Inc.
PO Box 104
Terryville, CT 06786-0104
(203) 589-6359

Mobile Electronics Association
2101 L St. NW, Suite 400
Washington, DC 20037
(202) 828-2270

National Alarm Association of America
14 S. Cass Ave.
Westmont, IL 60559-1864
(708) 810-1474
(800) 283-6285

National Burglar and Fire Alarm Association
7101 Wisconsin Ave., Suite 1390
Bethesda, MD 20814-4805
(301) 907-7897

National Locksmith Suppliers Association
1900 Arch St.
Philadelphia, PA 19103-1498

Safe and Vault Technician's Association
5083 Danville Rd.
Nicholasville, KY 40356

SafeCracker International
National Antique Safe Association
P.O. Box 110099, 1142 Nucla St.
Aurora, CO 80011
(303) 340-1524

INTERNATIONAL ASSOCIATIONS

Master Locksmiths Association of Australia LTD.
P.O. Box 794, Dandenong, Vic., 3175
Australia
(03) 794-9975

Belgian Locksmith Association-GBSS
St. Michiel Sstraat 2, B-9000
Gent, Belgium
32 91 230 210

Danish Locksmith Association-DLF
Borups Alle' 129, DK-2000
Frederiksberg, Denmark
45 38 34 89 07

Master Locksmiths Association
Units 4 & 5, The Business Park
Woodford Halse, Daventry
England NN11 6PZ
44 327 622 55

Finnish Locksmiths Association-FLF
Fredrikinkatu 57, SF-00100
Helsinki
Finland
358 0 694 7044

Interkey
Muhlentorsts 17, D-4450
Lingen (Ems)
Germany
49 5915 1079

Dutch Locksmith Organization-NSSG
P.O. Box 5254, NL-3008 Ag
Rotterdam
Holland
31 76 14 25 61

Hong Kong Trade Development Council
673 Fifth Ave.
New York, NY 10022
(212) 838-8688

Associated Locksmith of Ireland
c/o S&D Security Devices Ltd.
The Lock Shop,6, Merrion St., Lower,
Dublin 2
Republic of Ireland
35 31 613 518

Lock and Relock Experts
Esperti Riferme Serrature Italia-Ersi
Viale Umbria 2, 120090
Fizzonasco Dipieve (MI)
Italy
39 2 9072 4526

Norwegian Locksmiths Association-NL
Postboks 70, N-1406
Hebekk, Norway
47-9-87-1 8-56

Apecs
Arragueta, 3 bajo P. Post 526
E-20600
Eibar, Spain
Fax: 3 49 43 11 86 99

Swedish Master Locksmiths Association-SLA
Box 284, S-127 25
Skarholmen, Sweden
46 8 740 59 55

European Locksmiths Association-ELF
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Skarholmen, Sweden
46 8 740 59 55

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Decatur, AL 35602
(205) 353-2596

Alaska Locksmith Association
Box 72895
Fairbanks, AK 99707

Grand Canyon Chapter, ALOA
850 E. 24th St.
Yuma, AZ 85365
(602) 726-8643

Ark-La-Tex Locksmith's Association
c/o Debbie Motschman
1387 Airline Dr.
Bossier City, LA 71112
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California Locksmiths Association
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Buena Park, CA 90621
(714) 521-6000

Gold Coast Locksmith Association
19425 Soledad Canyon Rd., Ste. 3490
Canyon Country, CA 91351

Central and Southern Colorado Locksmith Assn.
P.O. Box 392
Colorado Springs, CO 80901

Rocky Mountain Locksmiths Association
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Denver, CO 80201

Locksmith Association of Connecticut, Inc.
P.O. Box 2080
Vernon, CT 06066
(203) 871-9447

Institutional Locksmiths' Assn.
Mid-Atlantic Chapter
P.O. Box 1348
Landover, MD 20785

Locksmiths' Association of Washington, D.C. Area, Inc.
Washington, DC area Chapter 5, ALOA
c/o Locks Unlimited, Inc.
7014 Bedrock Rd.
Alexandria, VA 22306-1209
(703) 960-6413

Central Florida Locksmith Association
P.O. Box 204
Winter Park, FL 32790-0204

Florida West Coast Locksmith Association
503 W. Platt St.
Tampa, FL 33606
(813) 253-5305

Florida West Coast Chapter of ALOA
W. Nick Ray, Jr., CPL
4410 McElroy Ave.
Tampa, FL 33611
(813) 831-4433

State of Florida Locksmiths Association
P.O. Box 14322
Ft. Lauderdale, FL 33302

Dixie Locksmith Association, Inc.
129 Sunset Lane
Albany, GA 31705
(912) 888-7233

Hawaii Chapter, ALOA
P.O. Box 23360
Honolulu, HI 96823-3360
(808) 924-9644

The Greater Chicago Locksmiths' Association
6124 N. Milwaukee, Suite 11
Chicago, IL 60646
(312) 631-2970

Northern Illinois Locksmiths' Association
38482 N. Sheridan Rd.
Waukegan, IL 60087

Associated Locksmiths of Indiana
P.O. Box 2714
Indianapolis, IN 46206

Iowa Locksmith Association
c/o Ronald White
806 2nd Ave. W.
Oskaloosa, IA 52577
(515) 673-5450

Great Plains Locksmith Association
c/o Mark G. Davis
1331 S. Sycamore St.
Liberal, KS 67901
(316) 624-6270

Central States Locksmith Association
c/o David Kerr
Sec, 6 Carol Ct.
New Albany, IN 47150
(812) 948-0569

Louisiana-Mississippi Locksmith Association, Inc.
c/o Peggy A. Benfer, RL
P.O. Box 643
Meridian, MS 39302-0643

Pine Tree State Locksmith Association, Inc.
c/o James (Rip) Thibodeau
RFD 4, Box 79
Ellsworth, ME 04605
(207) 667-5369

Maryland Locksmiths Association
2 Mellor Ave.
Baltimore, MD 21228
(301) 747-5625

Massachusetts Locksmith Association, Inc.
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Woburn, MA 01888

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Dearborn Heights, MI 48127

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Prior Lake, MN 55372

Gateway Locksmith Association
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St. Louis, MO 63163
(314) 865-4720

Missouri-Kansas Locksmith Association
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Kansas City, MO 64119
(913) 562-3494

Montana Locksmith Association
130 E. 6th Ave.
Helena, MT 59601
(406) 443-5583

Nebraska Locksmiths Association, Inc.
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Hastings, NE 68901
(402) 463-6565

Nevada Professional Locksmiths Association, Inc.
c/o Gene Altobella, Pres.
1201 South Casino Center
Las Vegas, NV 89104
(702) 382-1754

New Hampshire Locksmiths Association, Inc.
Donald Carlson Sr.
RFD1, Box 362 B Bean Hill Rd.
Northfield, NH 03276
(603) 286-8428

Master Locksmith Association of New Jersey
P.O. Box 2441
Morristown, NJ 07962-2441

New Jersey Locksmiths Association
P.O. Box 941
Piscataway, NJ 08854

New Mexico Locksmith Association
4200 Wyoming NE
Albuquerque, NM 87111
(505) 293-6552

Adirondack Hudson Master Locksmith Association
351 Central Ave.
Albany, NY 12206
(518) 462-5467

Central New York Locksmiths Association
c/o Fradon Lock Co. Inc.
467 Burnet Ave.
Syracuse, NY 13203
(315) 472-6988

Institutional Locksmiths' Association
New York Area Chapter
212 East Broadway Ste. G601
New York, NY 10002

New York Locksmiths Association, Inc.
c/o Adrienne Star
P.O. Box 6862, Fresh Meadows St.
Flushing, NY 11375

North Carolina Locksmiths Association, Inc.
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809 Wicker St.
Burlington, NC 27217
(919) 227-7559

Northern Prairie Locksmith Association
2610 Main Ave.
Fargo, ND 58103
(701) 293-7138

Professional Locksmith Guild
Al Taylor, Pres.
P.O. Box 7217
Milford, OH 45150
(513) 248-9659

Oklahoma Master Locksmith Association
c/o Jackie Roberts, Sec.
11910 SE 44th St.
Oklahoma City, OK 73150-2914
(405) 732-5838

Oregon Association of Professional Locksmiths
c/o Ervan Smith
P.O. Box 4734
Salem, OR 97302

Pacific Locksmith Association
c/o Hugh Phillips
P.O. Box 83688
Portland, OR 97283-0688

Central Pennsylvania Locksmith Association
1937 Princeton Ave.
Camp Hill, PA 17011

The Greater Philadelphia Locksmiths Association
P.O. Box 11101
Philadelphia, PA 19136

Penn-Ohio Locksmith Association, Inc.
2978 Sandy Lake Rd.
Ravenna, OH 44266
(216) 297-6466

South Carolina Locksmith Association
P.O. Box 264
Camden, SC 29020
(803) 432-8099

East Tennessee Locksmiths Association
201 W. Main St.
Johnson City, TN 37604
(615) 928-0926

Greater Dallas Locksmith Association
c/o Hans Johnsen Co.
8901 Chancellor Row
Dallas, TX 75247
(800) 678-1560

Locksmith Association of San Antonio
c/o Dee Bucha
518 Junction Hwy.
Kerrville, TX 78028

The Texas Locksmiths Association
c/o Paul F. Newell, C.P.L., Sec.
8414 Silver Star
San Antonio, TX 78218
(512) 657-1224

Beehive State Locksmith Association
P.O. Box 65823
Salt Lake City, UT 84115
(801) 266-5083

Green Mountain Locksmiths Association, Inc.
c/o D.A. Keenan
P.O. Box 246
Essex, VT 05451
(802) 878-4694

Tidewater Locksmiths Association, Inc.
P.O. Box 68244
Virginia Beach, VA 23455

Virginia Locksmiths Association, Inc.
7408 Parrish Lane
Manassas, VA 22110
(703) 631-1682

Northwest Locksmith Association
P.O. Box 75049
Seattle, WA 98125
(509) 663-5610

West Virginia Tri-State Area Locksmith Association
2846 Overlook Dr.
Huntington, WV 25705
(304) 522-2499

Wisconsin Locksmiths Association
c/o Debra Soderland
5124 W. Howard Ave.
Milwaukee, WI 53220

Wyoming Locksmith Association
413 Randall Ave.
Cheyenne, WY 82001
(307) 634-2915

C

Locksmith supply distributors

Accredited Lock Supply Co.
1161 Patterson Plank Rd.
Secaucus, NJ 07094
(800) 652-2835

Absolute Security
9510 W. Park
Houston, TX 77063
(800) 880-0787

Access Sales, Inc.
5518 Dorsey Lane
Bethesda, MD 20816
(800) 333-9570

Bell's Security Sales
411 Bloomfield Ave.
Bloomfield, NJ 07003
(800) 772-2266

Baylis Corp.
7 Pamaron Way
Novato, CA 94949
(800) 227-0503

Boston Lock & Safe Co.
30 Lincoln St.
Boston, MA 02135
(800) 252-5757

Clark Security Products
7140 Engineer Rd.
San Diego, CA 92122

CLK Supplies
West 45 Hayden Ave.
Hayden Lake, ID 83835
(208) 772-4092

Commonwealth Lock Co.
1853 Massachusetts Ave.
Cambridge, MA 02140
(800) 442-7009

Dimark International Inc.
3117 Liberator St., Unit A
Santa Maria, CA 93455
(800) 235-2435

D. Silver Hardware Co. Inc.
591 Ferry St.
Newark, NJ 07105
(800) 222-2915

Dugmore & Duncan, Inc.
30 Pond Park Rd.
Hingham, MA 02043
(800) 225-1595

El Jay Express
P.O. Box 1388
Wheeling, IL 60090
(708) 480-1311

Empire Security Supplies
4600 B Nesconset Hwy.
Port Jefferson Station, NY 11776
(516) 928-1919

Ewert Wholesale Hardware, Inc.
4709 W. 120th St.
Alsip, IL 60658
(800) 451-0200

Foley-Belsaw Co.
Locksmith Supply Div.
6301 Equitable Rd.
Kansas City, MO 64120
(800) 821-3452

Fried Brothers
467 N. 7th St.
Philadelphia, PA 19123
(800) 523-2924

Fradon Lock Co., Inc.
467 Burnet Ave.
Syracuse, NY 13203
(800) 447-0591

Garden State Hardware Wholesalers
322-324 W. Front St.
Plainfield, NJ 07060
(800) 544-0616

Gem Security Consultants, Ltd.
5 N. Wabash Ave., Ste. 908
Chicago, IL 60602
(800) 223-4100

Gil-Ray Tools, Inc.
1306 McGraw St. Box 801
Bay City, MI 48707
(517) 892-6870

High Tech Tools
1400 S.W. 1st St.
Miami, FL 33135
(800) 323-8324

House of Security
151 E. 5th Ave.
Columbus, OH 43201
(614) 291-7715

H.S. & S. Wholesale Distributors
12915 W. Eight Mile Rd.
Detroit, MI 48235
(800) 482-3000

Ilco/USA S.A. de C.V.
Genaro Garcia 110, Col. Jardin
Balbunea
CP 15900 Mexico D.F.
Mexico
531-2594-3036

Independent Hardware Inc.
14 S. Front St.
Philadelphia, PA 19106
(800) 346-9464

Island Pacific Distributors, Inc.
1668 King St., P.O. Box 22189
Honolulu, HI 96822
(808) 955-1126

JLM Wholesale
3204 Adventure Lane
Oxford, MI 48371
(800) 522-2940

Julie Products, Inc.
67-59 Woodhaven Blvd.
Rego Park, NY 11374
(800) 242-3289

J.W.I. Supply Inc.
105 W. Main St.
Jenks, OK 74037
(800) 288-1255

Kenco Locksmith Supply Co.
2531 N. 85th St.
Omaha, NE 68134
(800) 228-2266

Keystone Safe & Equipment Wholesalers
625 S. 8th St.
Philadelphia, PA 19147

Klein Bros, Inc.
1101 W. Broadway
Louisville, KY 40203
(502) 587-6886

Lock & Key Wholesale Distributors, Inc.
1229 1st Ave.
S. Birmingham, AL 35233
(205) 252-2427

Lockmasters
5085 Danville Rd.
Nicholasville, KY 40356
(800) 654-0637

Lock Supply Co., Inc., The
1613 W. Pratt St.
Baltimore, MD 21223-2493
(410) 233-4022

Mayflower Sales Co., Inc.
614 Bergen St.
Brooklyn, NY 11238
(800) 221-2052

Maziuk & Co., Inc.
1251 W. Genesee St.
Syracuse, NY 13204
(800) 777-5945

M B Key
P.O. Box 3171
Alhambra, CA 91803
(213) 725-6699

New York Key Service
1040 N. Western Ave.
Los Angeles, CA 90029
(213) 469-2183

N&N Distributing
5631 Madison Ave.
Indianapolis, IN 46227-4670
(317) 784-1298

Northern Lockpak
P.O. Box 32198
Tucson, AZ 85751-2198
(800) 433-2389

O'Brien Brothers, Inc.
380 Union St.
W. Springfield, MA 01089
(413) 734-7121

Omaha Wholesale Hdwe.
P.O. Box 3628
Omaha, NE 68103
(800) 228-8694

Orchard Lock Distributors
30 Edmond St.
Hampden, CT 06517
(800) 233-2146

Pimlico Key Service, Inc.
5254 Reisterstown Rd.
Baltimore, MD 21215
(800) 638-3815

Potomac Products
Box 110-D
Hustontown, PA 17229
(717) 987-3107

Personal Security
P.O. Box 496
Hoosick Falls, NY 12090
(800) 446-6223

Papaiz U.S.A. Ltd.
1075 W. Sam Houston Pkwy. N., Ste. 208
Houston, TX 77043
(713) 467-7196

QSI Systems, Inc.
7B Raymond Ave. Unit 8
Salem, NH 03079
(603) 893-7707

Ray Ware Hardware
4045 Herschel St.
Jacksonville, FL 33205
(800) 331-2063

Reed Code Books
850 Busse Hwy.
Park Ridge, IL 60068
(708) 692-5940

Rutherford Controls Inc.
2697 International Pkwy., Ste. 122
Parkway Bldg. 3
Virginia Beach, VA 23452
(800) 899-LOCK

Security Lock Distributors
59 Wexford St., P.O. Box 815
Needham Heights, MA 02194
(800) 847-5625

Steadfast Corp.
229 Marginal St.
Chelsea, MA 02150
(617) 889-3400

Standard Wholesale Hardware, Inc.
42 Ludlow St.
New York City, NY 10002
(212) 353-0450

Texidor Security Equip. Inc.
GPO No. 3867
San Juan, PR 00936
(809) 798-1313

Top Notch Distributors, Inc.
P.O. Box 488
Honesdale, PA 18431
(800) 233-4210

Treskat
P.O. Box 422287
Kissimee, FL 34742-2287

Universal Key Supply
537 Heathcote Rd.
Lindenhurst, NY 11757
(516) 957-8315

U.S. Industrial Products Corp.
96-12 43rd Ave.
Corona, NY 11368
(212) 335-3300

Vanguard SMR Inc.
P.O. Box 751, 70 Main St.
Matawan, NJ 07747
(800) 524-2432

Veehoff Supply Co.
P.O. Box 361, 908 Lake Ave.
Storm Lake, IA 50588
(712) 732-1836

Vern Rose Tool
8605 Commerce
San Diego, CA 92121
(619) 560-9769

Waldron's Security Systems
90 Knox Ct.
Denver, CO 80219
(800) 255-0701

Webster Safe & Lock Co., Inc.
3020 Millbranch Rd.
Memphis, TN 38116
(901) 332-2911

Wilco Supply
5960 Telegraph Ave.
P.O. Box 3047
Oakland, CA 94609
(800) 745-5450

Yohar Supply
P.O. Box 327
Elyria, OH 44036
(800) 362-7416

Zeldin Auto Locks
1700 N. 5th St.
Philadelphia, PA 19122
(215) 236-8600

D

Lock manufacturers

A-1 Security Mfg. Corp.
3528 Maryland Court
Richmond, VA 23233
(804) 747-0095

Ademco
165 Eileen Way
Syosset, NY 11791
(516) 921-6700

Arrow
Sub. of Securitas Lock Group, Inc.
Sls/Mkg: 555 Long Wharf Dr., Ste. 12
New Haven, CT 06511
(800) 221-6529

Assa High Security Locks
103-00 Foster Ave.
Brooklyn, NY 11236
(718) 927-2772

AWI
Div. Ilco Unican
400 Jeffreys Rd.
Rocky Mount, NC 27804
(800) 334-1381

Baldwin Hardware Corp.
841 E. Wyomissing Blvd.
Reading, PA 19612
(215) 777-7811

Best Lock Corp.
P.O. Box 50444
6165 E. 75th St.
Indianapolis, IN 46250
(317) 849-2250

Briggs & Stratton Technologies
P.O. Box 702
Milwaukee, WI 53201
(414) 259-5333

CCL Security Products
199 Whiting St.
New Berlin, CT 06050
(800) 733-8588

Chicago Lock Co.
4311 W. Belmont Ave.
Chicago, IL 60641
(312) 282-7177

Corbin Arch. Hardware
A Black and Decker Co.
225 Episcopal Rd.
P.O. Box 4004
Berlin, CT 06037-4004

Dexter Lock
Subsidiary of Master Lock
300 Webster Rd.
Auburn, AL 36830
(800) 962-5770

Dom Security Locks
774 Quintin, P.O. Box 235
Saint Bruno, PQ J3V 4P9
Canada
(800) 363-4803

Dorma Door Controls
Dorma Dr.
Reamstown, PA 17567
(800) 523-8483

Eagle Security Products
5403 Sheila St.
Los Angeles, CA 90040
(800) 432-4534

ESP Corp.
Engineered Security Products
375 Harvard St.
Leominster, MA 01453
(508) 537-6121

Exit Security Inc.
Box 8276
Forth Worth, TX 76124
(800) 446-6775

Falcon Safety Products, Inc.
7129 Gerald Ave.
Van Nuys, CA 91406
(800) 432-5622

Fichet North America
1255-A Oakbrook Dr.
Norcross, GA 30093

Folger Adam Co.
16300 W. 103rd St.
Lemont, IL 60439
(708) 739-3900

Gainsborough Hardware Indust., Inc.
3640 Windsor Park Dr., NE, Suite 100
Suwanee, GA 30174
(800) 845-5662

Gardall Safe Corp.
219 Lamson St.
P.O. Box 30 Eastwood Sta.
Syracuse, NY 13206
(800) 722-7233

Gil-Ray Tools
1306 McGraw St., Box 801
Bay City, MI 48707

High Tech Tools
P.O. Box 450370
1400 SW First St.
Miami, FL 33135
(800) 323-8324

HPC Inc.
3999 N. 25th Ave.
Schiller Park, IL 60176
(708) 671-6280

Hudson Lock, Inc.
81 Apsley St.
Hudson, MA 01749
(508) 562-3481

Ideal Security Hardware Corp.
Rte. 16, Box 133
Gray, TN 37615
(800) 326-1467

Ilco Unican Corp.
400 Jeffreys Rd.
Rocky Mount, NC 27804
(919) 446-3321

International Door Closers, Inc.
1140 N. Kraemer Pl.
Anaheim, CA 92806
(800) 544-4422

Jackson Exit Device
Sub. of Thomas Ind. Inc.
3447 Union Pacific Ave.
Los Angeles, CA 90023
(800) 533-6229

J & B Key-Rite Mfg.
Rd. 1, Box 217
Rockwood, PA 15557
(814) 926-2176

Jet Hardware Manufacturing Corp.
800 Hinsdale
Brooklyn, NY 11207
(718) 257-9600

Kaba Security Locks, Inc.
Old Turn Pike
Southington, CT 06489
(203) 621-3601

Kent-Moore/Borroughs
Div. SPX Corp.
28635 Mound Rd.
Warren, MI 48092
(800) 345-2233

Kwikset Corp.
A Black & Decker Company
516 E. Santa Ana St.
Anaheim, CA 92805
(714) 535-8111

LAB
P.O. Box 350, Napco Dr.
Terryville, CT 06786

Lock & Supply Co.
620 Mamaroneck Ave.
Mamaroneck, NY 10543
(914) 698-8382

Lockmasters
5085 Danville Rd.
Nicholasville, KY 40356
(800) 654-0637

Locksmith Ledger
850 Busse Hwy.
Park Ridge, IL 60068
(708) 692-5940

Locksmith Publishing Co.
850 Busse Hwy.
Park Ridge, IL 60068
(708) 692-5940

Marks USA
5300 New Horizons Blvd.
Amityville, NY 11701
(800) 526-0233

Medeco Security Locks, Inc.
P.O. Box 3075
Salem, VA 24153
(703) 380-5000

Mul-T-Lock USA Inc.
300-1 Rt. 17S, Suite A
Lodi, NJ 07644
(201) 778-3222

National Cabinet Lock
P.O. Box 200
Mauldin, SC 29662
(803) 297-6655

National Security Products
1636 St. Clair Ave.
Cleveland, OH 44114
(216) 566-9962

Norton Door Controls
P.O. Box 25288
Charlotte, NC 28229-8010
(800) 438-1951

OEM Inc.
194 Daniel St.
Hackensack, NJ 07601
(201) 489-2184

Omni Tech Corp.
21950 Watertown Rd.
Waukesha, WI 53186
(414) 784-4112

Omnia Industries, Inc.
Box 330
Cedar Grove, NJ 07009
(201) 239-7272

Perry Blackburne, Inc.
354 Pine St., P.O. Box 6584
Providence, RI 02940
(800) 556-7474

Precision Hardware Inc.
38100 Jaykay Dr.
Romulus, MI 48174-0040
(313) 326-7500

Pro-Lok Co.
1060 N. Batavia St., Unit C
Orange, CA 92667
(714) 633-0681

Quality Hardware Co.
12705 S. Daphne Ave.
Hawthorne, CA 90251
(213) 757-2281

Rixon-Firemark, Inc.
9100 W. Belmont Ave.
Franklin Park, IL 60131
(800) 461-3007

Reed Code Books
850 Busse Hwy.
Park Ridge, IL 60068
(708) 692-5940

Russwin Architectural Hardware
A Black and Decker Co.
225 Episcopal Rd.
P.O. Box 4004
Berlin, CT 06037
(203) 225-7411

Safe and Vault Technology
5083 Danville Rd.
Nicholasville, KY 40356
(606) 885-3916

Schlage Lock Co.
P.O. Box 3324
San Francisco, CA 94119
(415) 467-1100

Supra Products
P.O. Box 3167
Salem, OR 97302
(503) 581-9101

Tech-Train Productions
P.O. Box 15401
Pensacola, FL 32514
(904) 476-7197

Teletron Security, Inc.
7798 Foothill Blvd.
Tujunga, CA 91042
(818) 352-5949

Texas Security Products, Inc.
2720 Royal Lane, Ste. 184
Dallas, TX 75229
(800) 527-8266

U-Change Lock Ind., Inc.
1640 W. Hwy. 152
Mustang, OK 73064
(800) 253-5625

Ultra Hardware Products
Box 679, Rt. 130 and Hylton Rd.
Pennsauken, NJ 08110
(800) 426-6379

United Security Products, Inc.
11065 Sorrento Valley Ct.
San Diego, CA 92121
(800) 227-1592

Universal Doortech
2783 E. 12th St.
Oakland, CA 94606
(415) 532-2202

Valentine Lock Products
Box 111
Yonkers, NY 10705
(914) 964-8877

Von Duprin, Inc.
2720 Tobey Dr., P.O. Box 6023
Indianapolis, IN 46206

VSI Hardware
Donner/Fortress
P.O. Box 445
12930 Bradley Ave.
Sylmar, CA 91342
(800) 882-0116

Waldron Security Systems
90 Knox Ct.
Denver, CO 80219
(800) 255-0701

Weslock
American Builders Hardware Corp.
13344 S. Main St.
Los Angeles, CA 90061
(310) 327-2770

Yale Locks and Hardware
Div. of Yale Security, Inc.
P.O. Box 25288
Charlotte, NC 28229-8010
(800) 438-1951

Z Lock Mfg. Co.
P.O. Box 949
Redondo Beach, CA 90277
(310) 372-4842

E

Related trade publications

Locksmith Ledger International
850 Busse Hwy.
Park Ridge, IL 60068
(708) 692-5940

Security Technology & Design
850 Busse Hwy.
Park Ridge, IL 60068
(708) 692-5940

The National Locksmith
1533 Burgundy Pkwy.
Streamwood, IL 60107
(708) 837-2044

Reed's Security Reporter
P.O. Box 814713
Dallas, TX 75381
(214) 980-9393

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